INSTRUCTION MANUAL

SEL

2000
DANAMETERS
2100

RACAL-DANA

RACAL

The Electronics Group

PUBLICATION NO. 980530

SERVICE INFORMATION

2000 DANAMETERS 2100

RACAL-DANA

RACAL-DANA INSTRUMENTS INC.
4 Goodyear Street, P.O. Box C-19541, Irvine, CA 92713
Telephone: 714/859-8999, TWX: 910-595-1136, TLX: 67-8341

RACAL-DANA INSTRUMENTS LTD.
Duke Street, Windsor, Berkshire SL4 1SB, United Kingdom
Telephone: Windsor (07535) 69811, TLX: 847013

RACAL-DANA INSTRUMENTS S.A.
18 Avenue Dutartre, 78150 Le Chesnay, France
Telephone: (3) 955-8888, TLX: 697 215

RACAL-DANA INSTRUMENTS GmbH.
Hermannstrasse 29, D-6078 Neu Isenburg, Federal Republic of Germany
Telephone: 06102-2861/2, TLX: 412896

RACAL-DANA INSTRUMENTS ITALIA srl.
20161 Milano, Via Angeloni 8, Italy
Telephone: (02) 6459558/6468189, TLX: 315697

RACAL

PUBLICATION DATE: JANUARY 1979

Copyright © 1979 by Racal-Dana Instruments, Inc. Printed in the United States of America. All rights reserved.
This book or parts thereof may not be reproduced in any form without written permission of the publishers.

PROPRIETARY NOTICE

This document and the technical data herein disclosed, are proprietary to Racal-Dana Instruments, Inc., and shall not, without express written permission of Racal-Dana Instruments, Inc., be used, in whole or in part to solicit quotations from a competitive source or used for manufacture by anyone other than Racal-Dana Instruments, Inc. The information herein has been developed at private expense, and may only be used for operation and maintenance reference purposes or for purposes of engineering evaluation and incorporation into technical specifications and other documents which specify procurement of products from Racal-Dana Instruments, Inc.

TABLE OF CONTENTS

Section	Title	Page
1	**DANAMETER DESIGN CONCEPTS**	1-1
1.1	The Meter	1-1
1.2	The LCD Display	1-1
1.3	The Digital Chip (IC)	1-1
1.4	The Analog Chip (IC)	1-1
1.5	The Switch (Function/Range)	1-1
2	**THEORY OF OPERATION**	2-1
2.1	The Analog Chip Circuits	2-1
2.2	Ohm Conversion Technique	2-1
2.3	AC Conversion Technique	2-1
2.4	DC Current Conversion Technique	2-1
2.5	The Reference Circuits	2-1
3	**DESCRIPTION & CONFIGURATION**	3-1
3.1	Introduction	3-1
3.2	Circuit Board Identification, Model 2000 (A)	3-1
3.3	Circuit Board Identification, Model 2100 (A)	3-1
3.4	Production Characteristics	3-1
3.5	Liquid Crystal Display	3-3
3.6	Display Mounting	3-3
3.7	Danameter Switch Profile (2000)	3-5
3.8	Danameter Switch Profile (2100)	3-6
3.9	Danameter Notes And Precautions	3-7
4	**BASIC OPERATION CONCEPTS**	4-1
4.1	Power And Current Consumption	4-1
4.2	Clock Circuit	4-1
4.3	Negative Power Supply	4-3
5	**TIMING & CONTROL SIGNALS**	5-1
5.1	General Description	5-1
5.2	Signal Integrate (3K)	5-1
5.3	Reference Integrate (IR)	5-1
5.4	Reference Integration Capacitor (CI)	5-1
5.5	Zero Crossing (ND)	5-1
5.6	Waveforms For Timing And Control	5-1
5.7	Test Instrument Measurement Considerations	5-1
6	**TROUBLESHOOTING**	6-1
6.1	Description	6-1
6.2	Calibration Check Definition	6-1
6.3	Switch Closure Chart Definitions	6-1
6.4	DC Voltage And Waveform Chart	6-1
6.5	Functional Schematic Diagram	6-1
6.6	Assembly Drawings	6-1

TABLE OF CONTENTS continued

Section	Title	Page
7	CONFIGURATION HISTORY & PARTS LIST	7-1
8	APPENDIX	8-1
8.1	Field Service Bulletin No. 20-1112	8-3
8.2	Field Service Bulletin No. 20-1113	8-7
8.3	Procedures To Replace Danameter Bent/Broken Contacts	8-9
8.4	Rework Instructions	8-11
8.5	Field Service Bulletin No. 20-11141	8-15

LIST OF ILLUSTRATIONS

Figure	Title	Page
2.1	Analog Chip Block Diagram	2-2
2.2	(Isolator) Signal Conditioner/Voltage-to-Current Converter Functional Block Diagram	2-3
2.3	Ohms Converter Functional Block Diagram	2-3
2.4	AC Converter Functional Block Diagram	2-4
2.5	DC Current Functional Block Diagram	2-5
3.1	2000 (A) and 2100 (A) Danameter Revision History Chart	3-2
3.2	Revision B&C LCD Connector Detail Drawing	3-3
3.3	LCD Retainer Connector Detail Drawing	3-4
3.4	Revision E LCD Connector Detail Drawing	3-4
3.5	2000 Revision B&C Switch Profile Drawing	3-5
3.6	2000 (A) Revision E Switch Profile Drawing	3-6
3.7	2100 (A) Switch Profile Drawing	3-6
4.1	Danameter Battery Interconnection Diagram	4-1
4.2	Danameter Current Test Set-up Diagram	4-1
4.3	Digital Clock Circuit	4-2
4.4	Clock Waveforms	4-3
4.5	Voltage Diameter Circuit	4-3
4.6	Negative Power Supply Waveforms	4-4
5.1	Danameter Control Signals	5-1
5.2	3K, Signal Integrate	5-2
5.3	IR, Reference Integrate	5-2
5.4	CI, Reference Integrate Capacitor	5-3
5.5	ND, Null Detect	5-3
5.6	True Time Relationship	5-4
6.1	Danameter Functional Schematic 2000 Danameter Rev. B & C	6-7
6.2	2000 Danameter (Rev. B & C) Assembly Drawing (Component Side)	6-8
6.3	2000 Danameter (Rev. B & C) Assembly Drawing (Circuit Side)	6-9
6.4	2000 Danameter (Rev. B & C) Switch Outline	6-10
6.5	Danameter Functional Schematic 2000 (A) Danameter Rev. E to T	6-19
6.6	2000 (A) Danameter (Rev. E to L) Assembly Drawing (Component Side)	6-20
6.7	2000 (A) Danameter (Rev. E to L) Assembly Drawing (Circuit Side)	6-21
6.8	2000 (A) Danameter (Rev. E to L) Switch Outline	6-22
6.9	Danameter Functional Schematic 2100 (A) Danameter Rev. A to H	6-29
6.10	2100 (A) Danameter (All Rev's) Assembly Drawing (Component Side)	6-30
6.11	2100 (A) Danameter (All Rev's) Assembly Drawing (Circuit Side)	6-31
6.12	2100 (A) Danameter (All Rev's) Switch Outline	6-32

LIST OF TABLES

Table	Title	Page
4.1	Battery Voltage Vs. LCD Readout	4-2
6.1	2000 Calibration Check (Rev. B&C)	6-2
6.2	Switch Closure Chart - Danameter Model 2000 (Rev. B & C)	6-3
6.3	Danameter 2000 (Rev. B & C) Reference Cell	6-4
6.4	2000 (A) Calibration Check (Rev. E to L)	6-11
6.5	Danameter Model 2000 (Rev. E to L)	6-12
6.6	Danameter 2000 (Rev. E to L) Reference Cell	6-13
6.7	Danameter 2000 (Rev. E to L) Reference Zener	6-14
6.8	2100 (A) Calibration Check (All Rev's)	6-23
6.9	Danameter Model 2100	6-24
6.10	Danameter 2100 (Rev. A to H)	6-25
7.1	2000 Parts List (Rev. to E)	7-2
7.2	2000 Parts List (Rev. to L)	7-5
7.3	2100 Parts List (Rev. to H)	7-8

SECTION 1 DANAMETER DESIGN CONCEPTS

1.1 THE METER.

1.1.1 The introduction of the Danameter (Model 2000) in January 1974 was one of the electronic test equipment industries first multimeters to offer a low-cost, low-power, portable, rugged 3 1/2 digit meter. The use of LSI (large scale integration) analog and digital IC's, a digital LCD (liquid crystal display), a single Function (Range) switch, and a minimal number of discrete components/hardware produced a multimeter with accuracy specifications that weren't available in meters using the conventional meter movements. Because of the low-power requirement, a simple 9 volt transistor battery is capable of providing operating power for 1 year; which can also be considered the calibration interval, under normal operating conditions.

1.2 THE LCD DISPLAY.

1.2.1 One of the most important factors in the Danameter design is the display. The field effect LCD, after being developed to produce long-term operating reliability was utilized because of its low-power consumption; when the year-long battery life goal was considered.

1.3 THE DIGITAL CHIP (IC).

1.3.1 Utilizing high-density C-MOS circuitry, the up-counting decade dividers are driven without interruption by the internal 8 to 10 KHz clock to ensure that timing signals for the dual-slope, analog-to-digital integrator on the analog chip are available continuously from the previous decade divider.

1.3.2 Since the dividers never stop counting, an array of latches was incorporated to extract the BCD decade count "on-the-fly" when the null detect strobe signal is received from the analog chip's control circuitry. The data, stored in the latches, is sent to an array of Seven segment decoders and to AC drivers for the LCD display.

1.4 THE ANALOG CHIP (IC).

1.4.1 With the 1 year, 9V battery consideration the total current drain was limited to 100 μA to maintain the following parameters:

1.4.2 High resolution and sensitivity: Resolution to better than 1 part in 2000 (3 1/2 digits). Sensitivity must be 100 μV per digit to meet the 200 mV (maximum voltage drop on the current ranges) specification.

1.4.3 Auto Polarity: The IC must accept inputs of either polarity, determine the polarity, and generate an appropriate signal for the LCD display.

1.4.4 High input impedance and low bias current: A basic input impedance > 1000MΩ and a bias current error of < 100 pA were specified to eliminate loading errors on the 10MΩ input divider.

1.4.5 Noise and overload immunity: The IC incorporates an active filter to reduce input noise without significantly affecting reading speed. The IC includes protective clamp circuitry to prevent damage from overloads and at the same time, detect and display overloads.

1.4.6 The analog chip design was based on the integration of low current NPN/PNP transistors, SCHOTTKY diodes, and thin-film resistors to keep the chip size small enough to produce high yields at low cost.

1.5 THE SWITCH (FUNCTION/RANGE).

1.5.1 The switch utilizes the etched traces on the printed circuit board as contact surfaces for spring contacts mounted and secured with a rivet/solder termination. The traces interconnect inputs, IC's, peripheral discrete components, and the LCD for the indicated Function and range selections. The switch detenting mechanism is fixed into the front portion of the meter case. The switch configures the meter for all ranges per function by opening and closing the PCB mounted spring contacts, actuated by the contact surfaces on the switch cam lobes.

SECTION 2 THEORY OF OPERATION

2.1 THE ANALOG CHIP CIRCUITS.

2.1.1 The block diagram in Figure 2.1 depicts the basic elements contained in the Analog LSI chip. The circuit shown in Figure 2.2 represents the 2-pole active filter/bootstrap and the voltage-to-current converter blocks of Figure 2.1. The configuration of U1 (signal or Hi isolator amp), U2 (Lo isolator amp), U3 (bootstrap amp) and the R-C discrete values (R1, C1, R2, C2) form a 2-pole low pass active filter to provide 50 dB of normal mode noise rejection @ 60 Hz, increasing 12 dB/octave. The output of U1 and U2 drive the voltage-to-current converter for the integration process.

2.1.2 For positive input voltages, Q1 and D2 conduct, due to the negative feedback around U1 (via Q1 or D1) causing a current nearly equal to Ein/Rg to flow in the collector of Q1, forcing the voltage ea to follow Ein. Feedback around U2 (via Q2 or D2) causes the voltage at eb to remain at a zero DC potential. No current flows through D1 or Q2 because they are reversed biased. Negative voltage inputs cause Q1 and D2 to turn off when collector current of Ein/Rg flows through Q2 and D1.

2.1.3 Because the voltage-to-current transfer is controlled only by Rg, the need for positive and negative input gain adjustments is eliminated. Voltage offsets of both op amps may be compensated with a single adjustment.

2.2 OHM CONVERSION TECHNIQUE.

2.2.1 The ratiometric ohms converter in Figure 2.3 performs by passing a constant current through, and measuring the resultant voltage drop, across the unknown resistance. The measuring current is generated by maintaining a constant voltage across a current-source resistor associated with each range. A precise 1 μA constant current source on the chip is established by the 1 volt drop across R6; which, when buffered by the ohms op amp, develops a constant 1 volt drop for each of the current source resistors, R2 to R5. The circuit accuracy is limited only by the current scaling resistors and is independent of the reference voltage. The measuring current is constant over each of the resistance ranges but is not the same for each range, as current and resistance are inversly proportional (see Table 2.1). The gain resistor for the 200 and 20KΩ ranges is decreased from 50KΩ to 5KΩ to increase the current demand from the integrator by the (isolator) voltage-to-current converter for a full scale display.

2.2.2 The filter component of C1 uses a .03 μf and .001 μf in parallel for all ohms ranges; except the 200MΩ range, which uses only the .001 μf to maintain an acceptable response speed for the meter reading.

Range	Current Resistor	Measurement Current	Rx Voltage Drop (FS)	Isolator Gain
200Ω	1KΩ	1mA	0.2V	X10
20KΩ	100KΩ	10μA	0.2V	X10
2MΩ	1MΩ	1μA	2.0V	X1
200MΩ	100MΩ	10μA	2.0V	X1

2.3 AC CONVERSION TECHNIQUE.

2.3.1 When the AC FUNCTION is selected, a switch closure enables a bias circuit on the analog chip to provide operating power to the active rectifier amplifier circuit. As shown in Figure 2.4 the input signal is applied to the input coupling capacitor to the switchable decade divider to provide an input to the active rectifier amplifier input of approximately 2 volts (p-p) for a full scale input signal. The non-signal input of the active rectifier (U4) is biased at a near zero potential by an external clamp diode circuit to protect the amplifier against damage in an over-voltaged input condition. The input divider produces X1, X.1, X.01, and X.001 attenuation factors for input signals from 2 VAC to 1000 VAC, respectively. The output is a plus rectified waveform at the cathode of D3 that is filtered by R10 and C3 to produce the average DC value of the waveform at the output of the rectifier amplifier. The DC value is then applied to the (isolator) voltage-to-current converter input with the gain resistor reduced in value to approximately 20KΩ to increase the current draw (by 2 1/2 times) from the integrator for full scale input signals.

2.4 DC CURRENT CONVERSION TECHNIQUE.

2.4.1 The input terminals connect the current path through one of the resistances of the current shunt, which produces a DC voltage to the input of the (isolator) voltage-to-current converter, whose gain resistor is 5K for a current increase of X10. An input diode clamp on all ranges (except 20 μA) and the fused "–" input lead provide the input protection for surge conditions.

2.5 THE REFERENCE CIRCUITS.

2.5.1 When the meter is set to any "on" position, the +9 volt battery is connected to provide operating power to the analog/digital chips and the +1.35 volt reference cell is

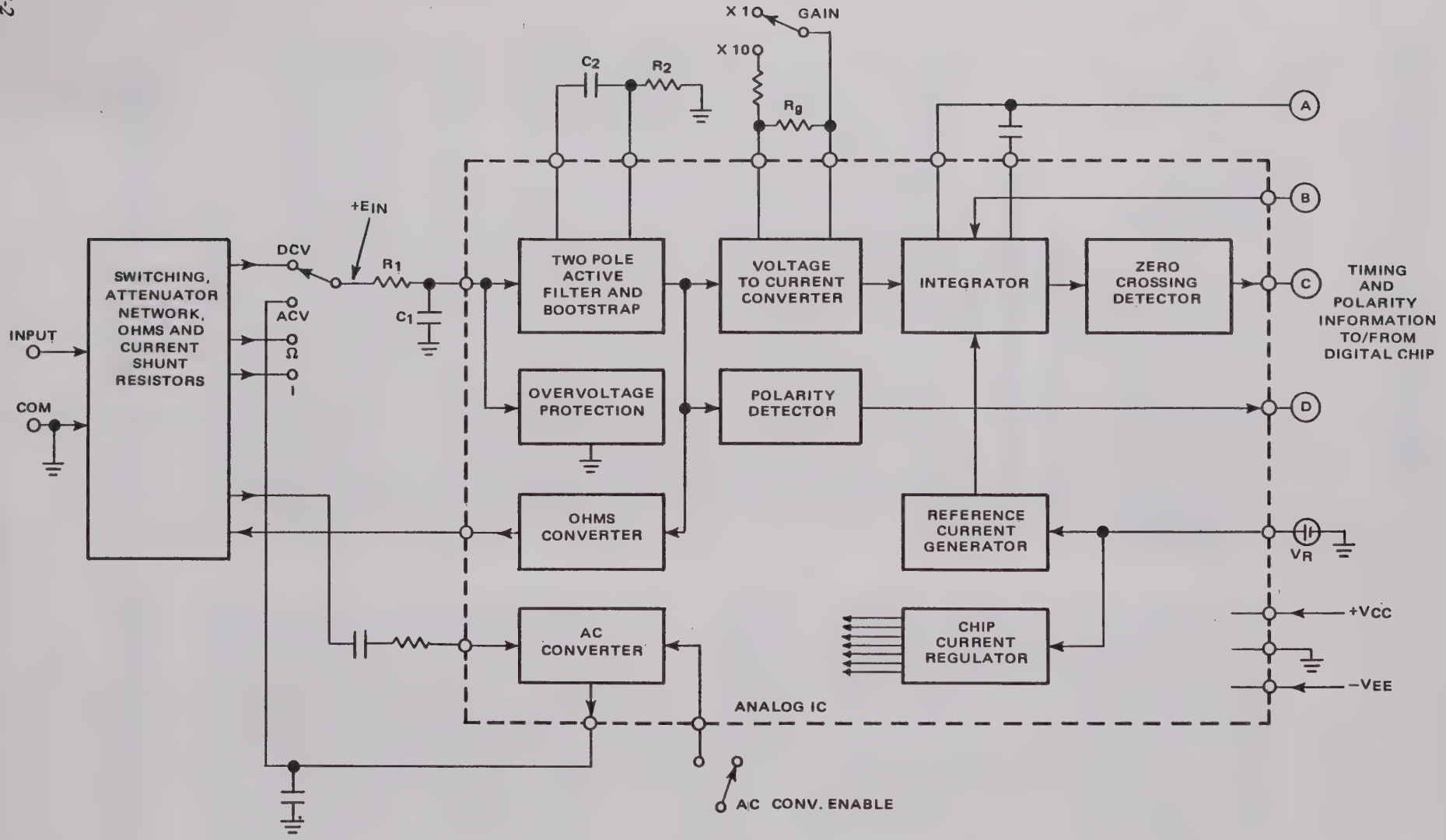


Figure 2.1 - Analog Chip Block Diagram

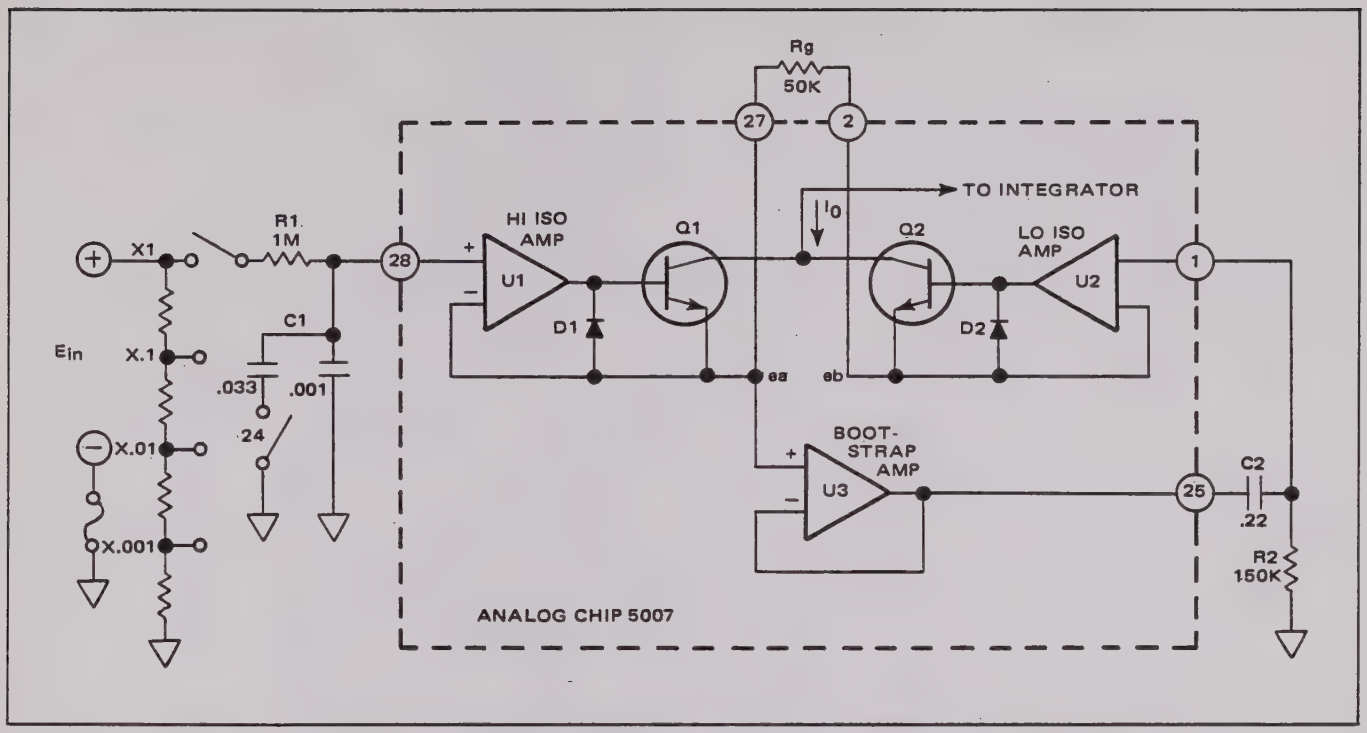


Figure 2.2 - (Isolator) Signal Conditioner/Voltage-to-Current Converter Functional Block Diagram

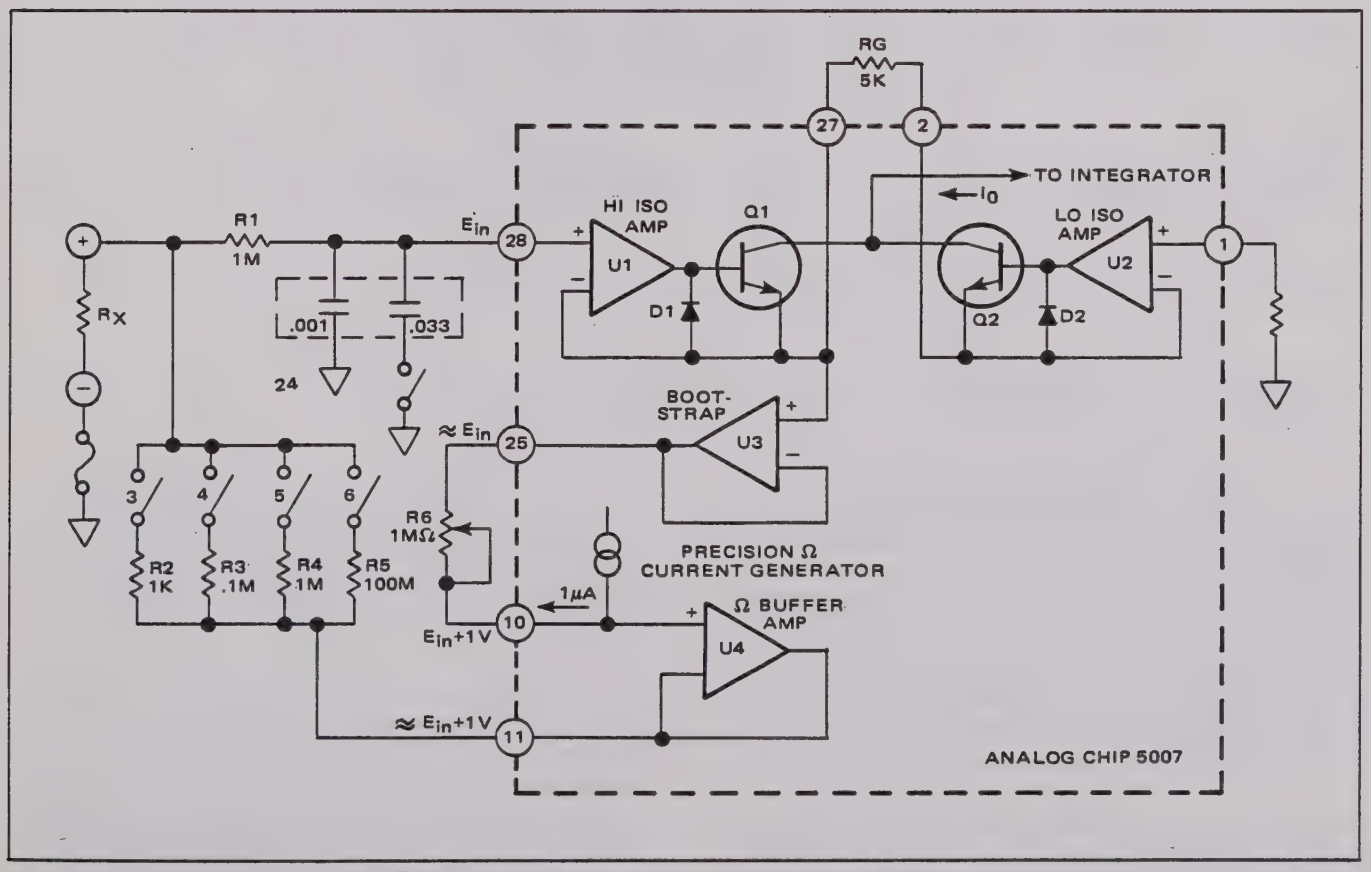


Figure 2.3 - Ohms Converter Functional Block Diagram

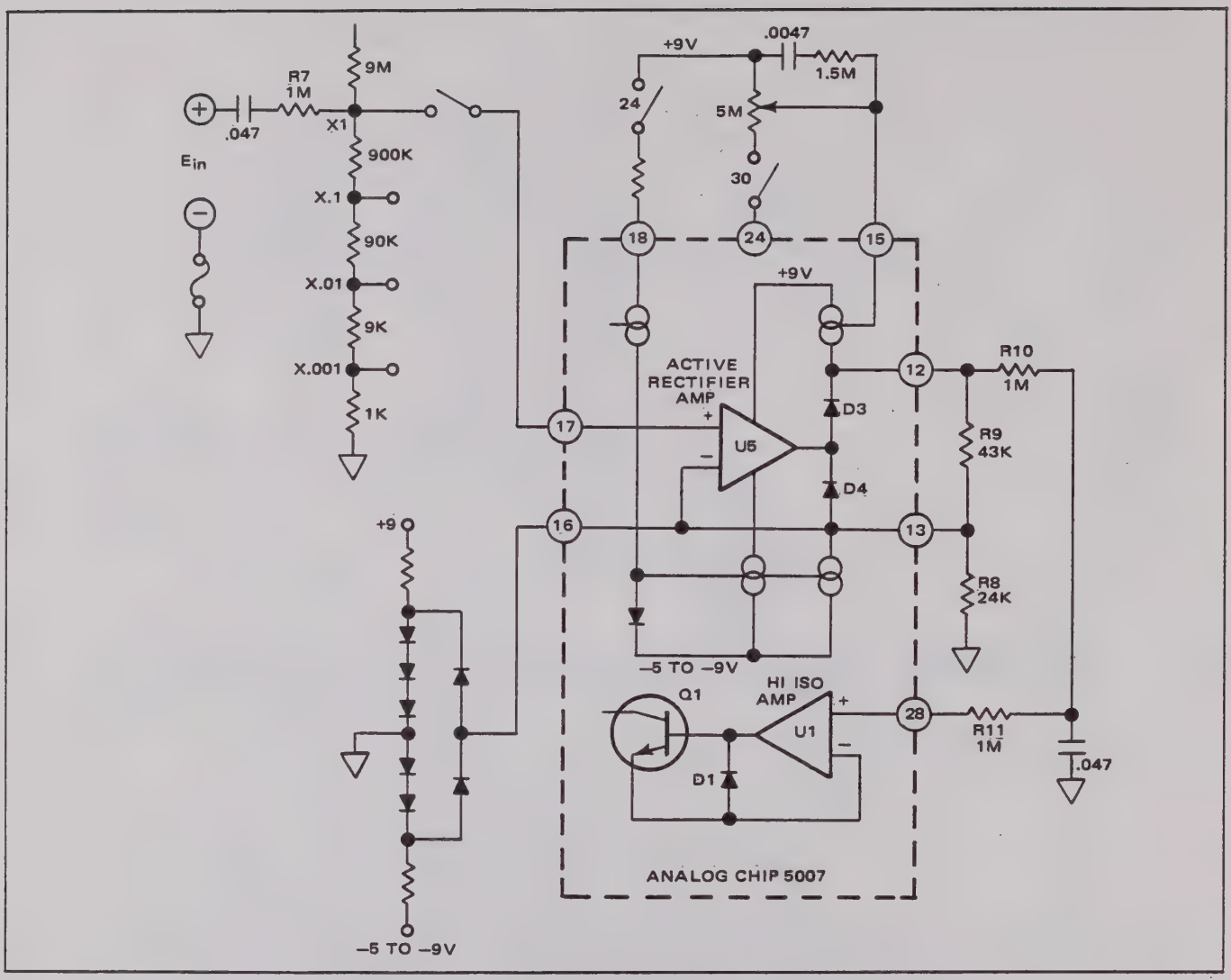


Figure 2.4 - AC Converter Functional Block Diagram

connected to the reference circuits that include the Reference Current Amplifier and the Chip Current Regulator.

2.5.2 The Chip Current Regulator biases "ON" all of the constant current circuits required for signal conditioning, voltage-to-current conversion, polarity detection, and Ohms Amplifier Circuit. The Reference Current Amplifier biases the integrator and Null Detector Circuit to process the current removed (signal integration) and added to (Reference Integration) the integrator amplifier. The Null Detector output signals the digital (chip) counter that a quiescent state (null) has been achieved and that the numerical count must be strobed into the latches and decoder/drivers.

2.5.3 The +1.35 volt Reference (mercury) cell is used to provide the voltage to operate the Reference Current Amplifier and the Chip Current Regulator because of its low power consumption and extreme stability with temperature and time.

2.5.4 The use of a zener diode, normally used to establish the stable reference voltage in dual-slope integrating meters, was originally bypassed because of the high bias current required to reach the constant voltage region (KNEE). Masking the zener diode onto the analog chip could reduce the chips yield; which would raise the price of the instrument.

2.5.5 The introduction of the improved Analog Chip (5007R), P/N 230188 made minor improvements but made interchangeability with the 5007 chip impossible. At the same time, a Reference zener diode, P/N 220076, was introduced as Option 03 to replace the +1.35 volt reference cell to achieve better stability without significantly reducing the 9 volt battery life due to the increased current demand.

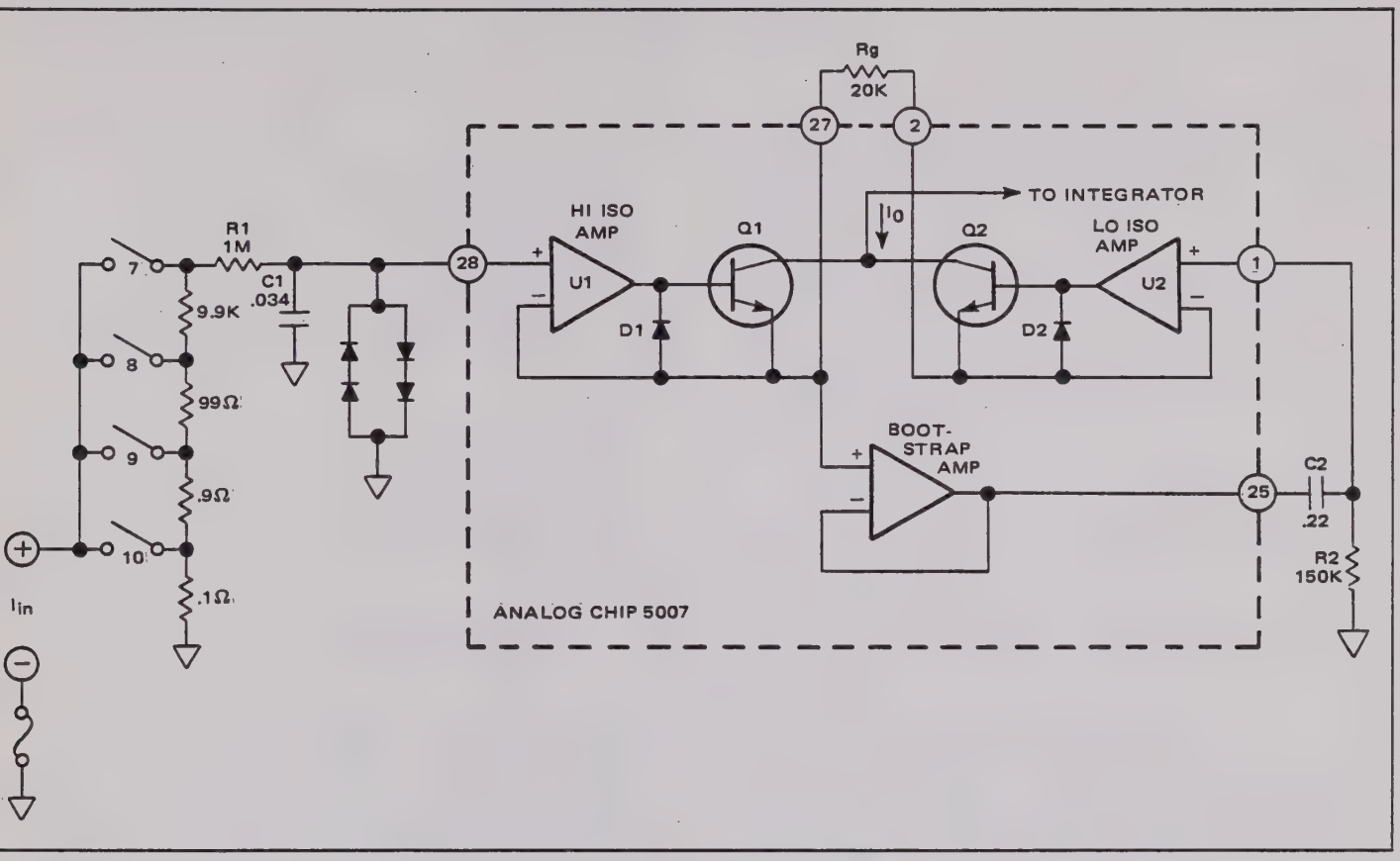


Figure 2.5 - DC Current Functional Block Diagram

2.5.6 The introduction of the latest LCD (readout) standardized the high stability reference zener in the 2000A and 2100A.

2.5.7 A rework procedure for the early 2000 Danameters, Revision B and C, to replace the Mercury Cell by adding the Reference Zener is included in the Appendix of this publication.

SECTION 3 DESCRIPTION & CONFIGURATION

3.1 INTRODUCTION.

3.1.1 From the beginning, the Danameter changed very little, except to improve the circuit performance and reliability by updating circuits, changing the value of components, and using improved hardware items. See Figure 3.1.

3.2 CIRCUIT BOARD IDENTIFICATION, MODEL 2000 (A).

3.2.1 The 2000 (A) Danameter printed circuit board (PCB) assembly number is 403767, but as this number does not appear on the assembly/references to 2000 (A) Danameter revisions will be made by the etched (artwork part number) "410679 Rev " that appears on the circuit side of the assembly.

3.3 CIRCUIT BOARD IDENTIFICATION, MODEL 2100 (A).

3.3.1 The 2100 (A) Danameter printed circuit board (PCB) assembly number is 403849, which does not appear on the assembly; but references to 2100 (A) Danameter revisions will be made by the etched (artwork part number) "410703 Rev " that appears on the circuit side of the assembly.

3.4 PRODUCTION CHARACTERISTICS.

3.4.1 The 2000 Danameters manufactured during 1974 will be Rev. B and C which are mainly characterized by:

A dull green liquid crystal display that;

a. Indicated overrange with a flashing 000 display,

b. Produced a numerical nine as instead of ,

c. Display window mounted on PCB assembly,

d. A paper-phelolic composition circuit board covered with a green solder mask, giving it a light green color,

e. An analog chip, 5007, P/N 230178,

f. 1.35V reference cell.

3.4.2 An improved analog chip was designed to be for the 2100 Danameter, which was also used in the 2000 meters at Rev. E. This was a major change for the 2000 because:

a. The analog chip is now a 5007R, P/N 230188 (not interchangeable),

b. Component reference designators changed (see parts list information in this document),

c. Liquid crystal display (LCD) changed (same part no. 920663),

d. LCD connector profile changed (see LCD conn section),

e. The function/range switch profile changed (see SW section),

f. Serial number was given a "EOO" prefix.

3.4.3 Except for minor revisions, the 2000 Danameter has changed very little to the present date, revision L. With the addition of a newer LCD in Jan '76, the model was designated 2000A.

3.4.4 The 2100 Danameter has maintained its same configuration from Rev. A to present date, Rev. H with the addition of a newer LCD in Jan '76, the model was designated 2100A.

CAUTION

Danameter models 2000 (to Rev. E and From Rev. E to date) equipped with the Reference Cell (1.35V battery) should be aware of the following precaution. When the multimeter is disassembled, for repair or recalibration, the Function (Range) switch should never be moved from the "OFF" position even while the 9V battery is disconnected. This can cause damage to the analog chip's internal reference amplifier circuits and may excessively "load" the reference cell, usually characterized by extremely unstable readings, a meter that will not operate/calibrate to specification, or enormous changes in the "test" readings.

		73	74											75											
		DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2000	403767	B	C	D	E			F	H		J				K	L			P		R		S			
	410679	B				C						D				E	F	H				J				
2100	403849														A	B		C		D		E		F		
	410703														A		B		C			D				

		76												77												78
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN
2000A	403767	S				T													U						V	
	410679	J					K							L												
2100A	403849	F																				H			J	
	410703	D				E				F				H												

		78											79											80	
		FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB
2000A	403767	V																								
	410679	L																								
2100A	403849	J																								
	410703	H																								

Figure 3.1 - 2000 (A) And 2100 (A) Danameter Revision History Chart

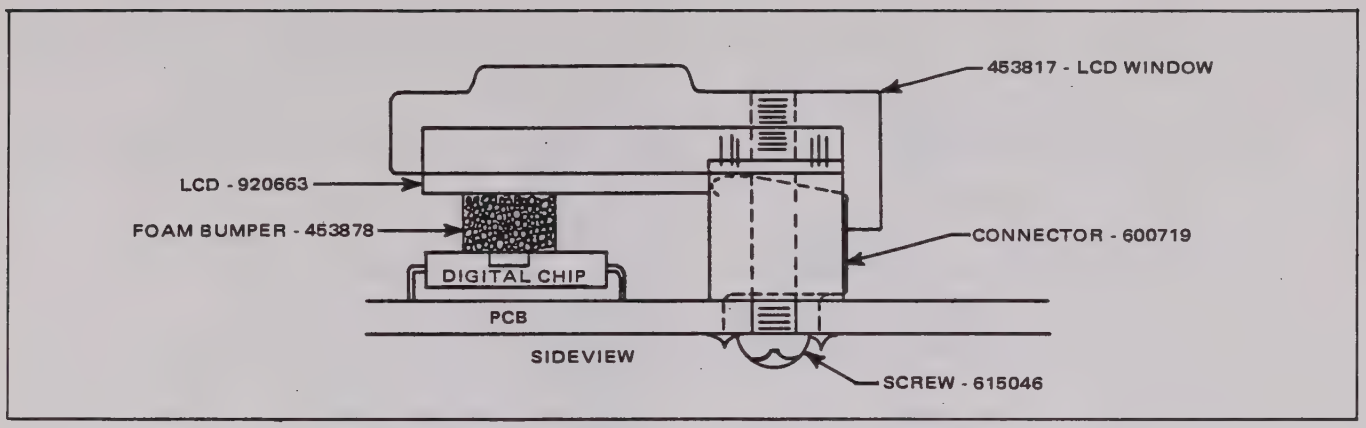


Figure 3.2 - Revision B&C LCD Connector Detail Drawing

3.5 LIQUID CRYSTAL DISPLAY.

3.5.1 There are three levels of the liquid crystal display used in the Model 2000(A) (two for the 2100(A)) that all retain the same part number, 920663; which will be identified by color and characteristics.

LCD 1 - Darker green color, readout portion covered with a polarized mylar tape to increase contrast. Segment change is relatively slow. Used on all revision B and some early C meters.

LCD 2 - Lighter green color, readout portion covered with a polarized mylar tape to increase contrast, but a parallox problem (angle view from perpendicular) was noticeable. Segment change much faster. Used on 2000, revision C to mid E meters and some early 2100's.

LCD 3 - Gray-green color, no discernable polarizing tape, but face of element is covered with a thin plastic lamination, subject to discoloration from extreme heat. Excellent contrast, not effected by parallox viewing and sharp, fast segment changes. Used on all current 2000(A) and 2100(A) Danameters.

CAUTION

If a meter is subject to extreme temperatures such as heat build-up in the trunk or dash-board of a car on a hot-sunny day, the readout may take on a mottled, or textured appearance. This is caused by the adhesive "field" (contrast for segments) partially de-laminating and it serves no useful purpose to remove it or the front lamination with a knife/razor blade. The LCD should be replaced for sharp, clear displays.

3.5.2 If the display, in the "OFF" position, seems to retain certain digit segments (very faintly) like they were "burned-in", as on the face of an old CRT; the LCD and digital chip should be replaced. This is prevalent in meters with marginal digital chip, usually caused by an over-voltaged condition in some function/range.

3.5.3 The LCD display can exhibit multiple decimal points if meteorological conditions cause the relative humidity, in hemispheric regions, to increase to the point where leakage develops in the decimal switches, decreasing the turn-off margin for the digital chip drive. See the field service bulletin for corrective action in the appendix of this publication.

3.6 DISPLAY MOUNTING.

3.6.1 From Jan '74 to June '74, 2000 Danameters, Rev. B and C, had the LCD captured in a Plastic Window, secured with self-tapping screws through the bottom of the PCB, and supported by a bumper on the digital chip to insure the LCD and window would protrude through the readout opening in the case.

3.6.2 This was a very rigid mounting arrangement that caused many problems with cracked/broken LCD elements due to excessive screw-tension and the inability of the meter to absorb impact, which was one of the features promoted. See Figure 3.2.

3.6.3 In June '74, the LCD window was replaced with a plastic retaining strap to capture the LCD. A conductive rubber strip (elastomer) was inserted between the LCD connector and LCD contact area to insure electrical contact, equalize the capture pressure of the new retaining strap, and increase the LCD ability to absorb more impact. The LCD window became part of the meter case. See Figure 3.3.

3.6.4 Some meters were still experiencing breakage and cracking from impact against the window in the meter case

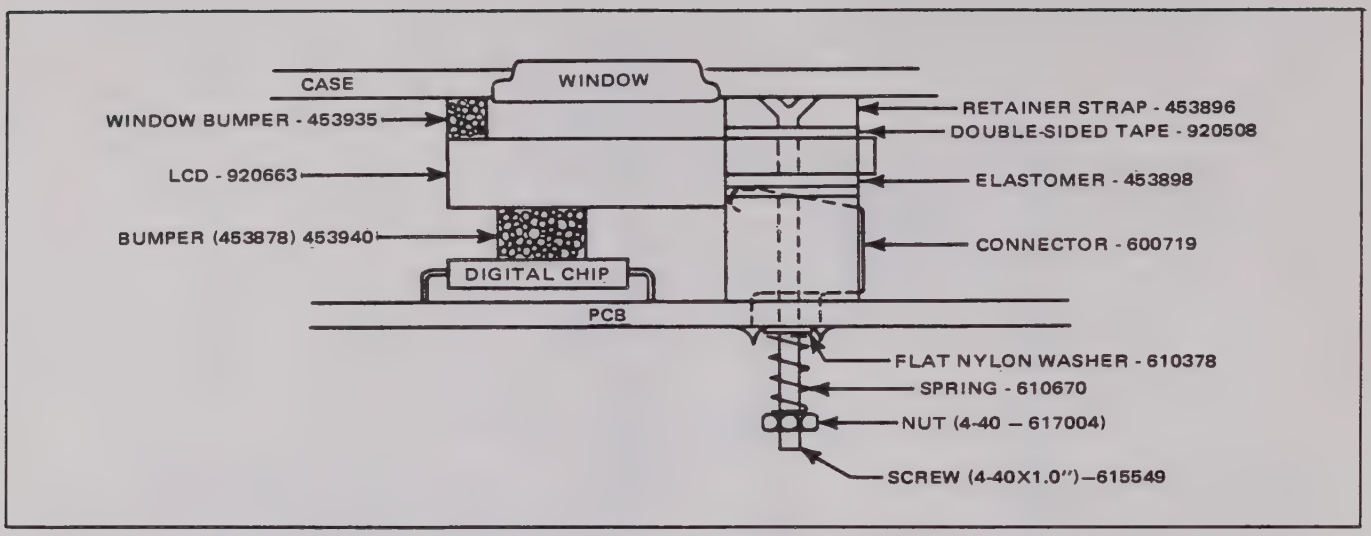


Figure 3.3 - LCD Retainer Connector Detail Drawing

but more meters were losing display segments caused by the LCD element shifting or coming free of the connector.

3.6.5 To solve this problem, the LCD contact area of the retainer strap was fitted with a strip of double-sided foam adhesive to prevent movement of the LCD. The Bumper on the digital chip was changed to P/N 453940 and a P/N 453935 bumper was added to the inside meter case above the window. This information was covered in Field Service Bulletin 20-1113, included in the appendix of this publication. Rev. E PCB changed the connector profile as shown in Figure 3.4.

3.6.6 The connector is positioned on the PCB by aligning the built-up shoulder in the holes for the mounting screws. The early connectors were white and had a very small shoulder dimension, which was later increased when the connector changed to black.

3.6.7 There is no solder connection between the PCB and the LCD. This connection is made by use of an elastomer contact (conductive rubber strip).

3.6.8 A small piece of foam tape was placed in the capture part of the connector to prevent LCD slippage.

3.6.9 The foam cushion bumper on the digital chip change part number (453686), changing the material density and dimension.

3.6.10 This connector profile is used on present 2000(A) and all 2100(A) Danameters.

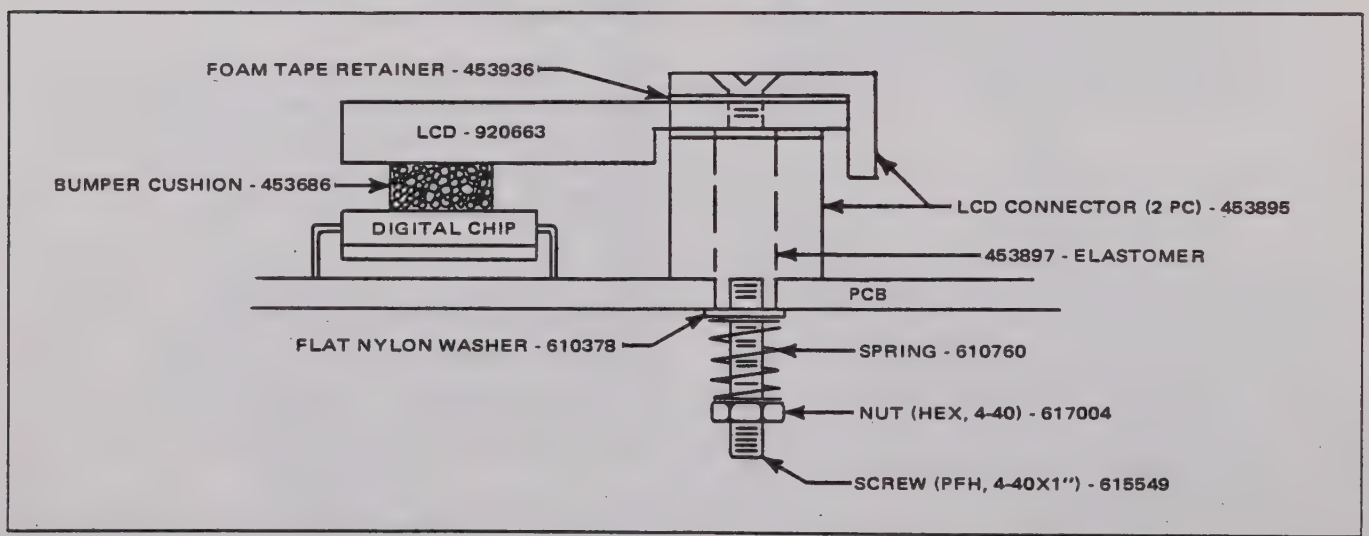


Figure 3.4 - Revision E LCD Connector Detail Drawing

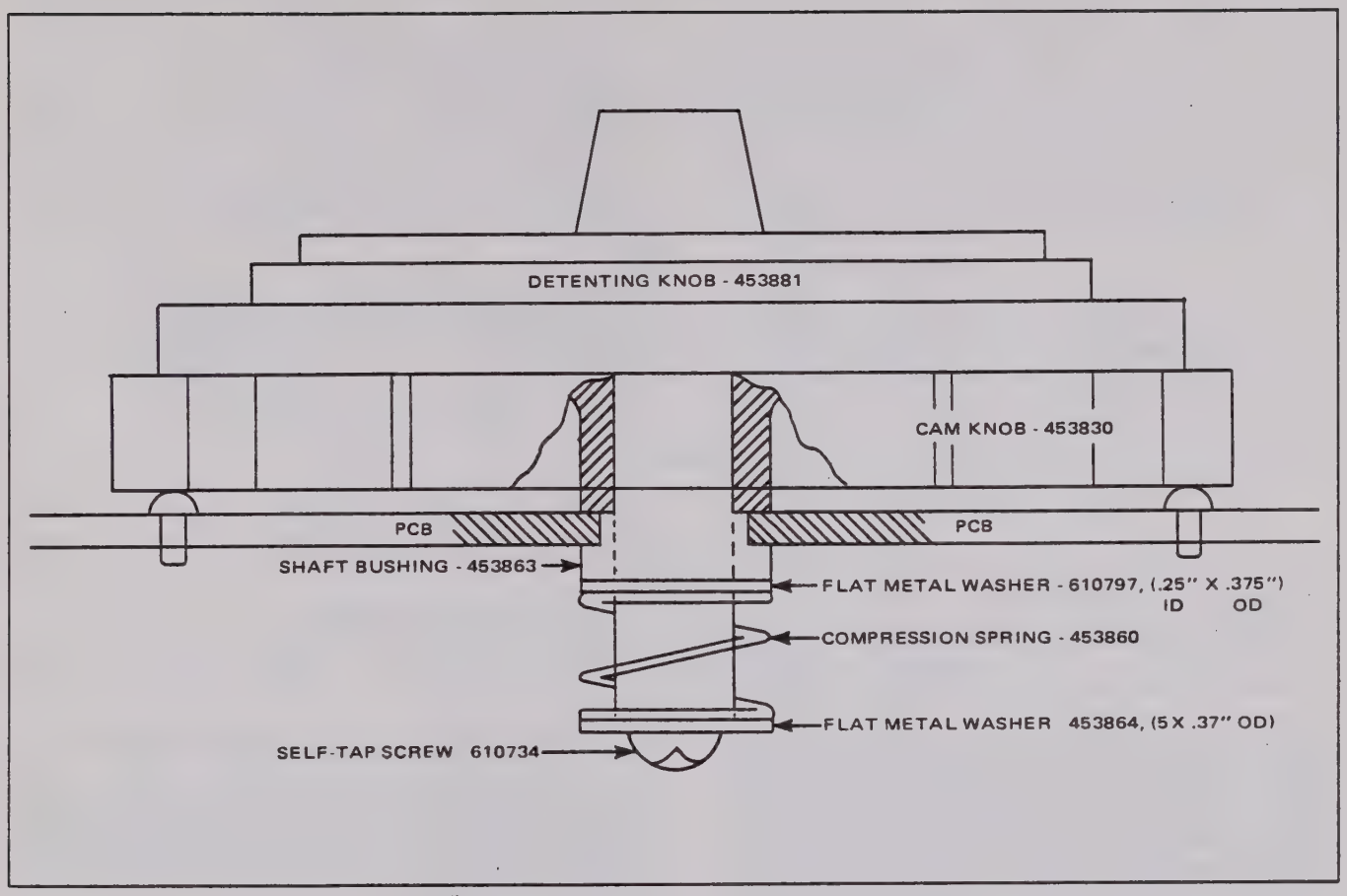


Figure 3.5 - 2000 Revision B&C Switch Profile Drawing

3.7 DANAMETER SWITCH PROFILE (2000).

3.7.1 Model 2000 B and C revision PCBs used a bushing, washer, spring, washer and screw to secure the detenting/ cam knob for proper switch operation. See Figure 3.5.

3.7.2 The disadvantage of this arrangement was that the shaft bushing could "catch" on the printed circuit board instead of properly "seating" in the PCB hole, which caused the switch to be "offset", preventing the switch cams from being properly aligned with the switch contacts. As a result of improper re-assembly, the first turn of the Function (Range) switch usually bent or broke several switch contacts, damaging the meter. If an input voltage happened to be present at the input terminals, usually more damage resulted.

3.7.3 Some Rev. C boards have a smaller diameter hole which cannot accept the shaft bushing. This was during the production period when the "E" revision PCBs were being designed for the revised analog chip. NOTE: The Revision "D" PCB never made the production cycle because of the switch problem and the transition to the new analog chip.

3.7.4 At Rev. E the shaft bushing was removed, the washer closest to the circuit board was changed to teflon, and a new compression spring was added to take up the "slack", now that the bushing had been removed.

3.7.5 In the very early Rev. E boards, the cam knob exerted too much pressure on the switch spring contacts, causing some problems with the circuit components actually being energized when the Function (range) switch was set to the "OFF" position. To relieve the pressure on the switch spring contacts, a flat metal washer was added to the detenting knob shaft before the switch knob assembly was secured to the PCB. See Figure 3.6.

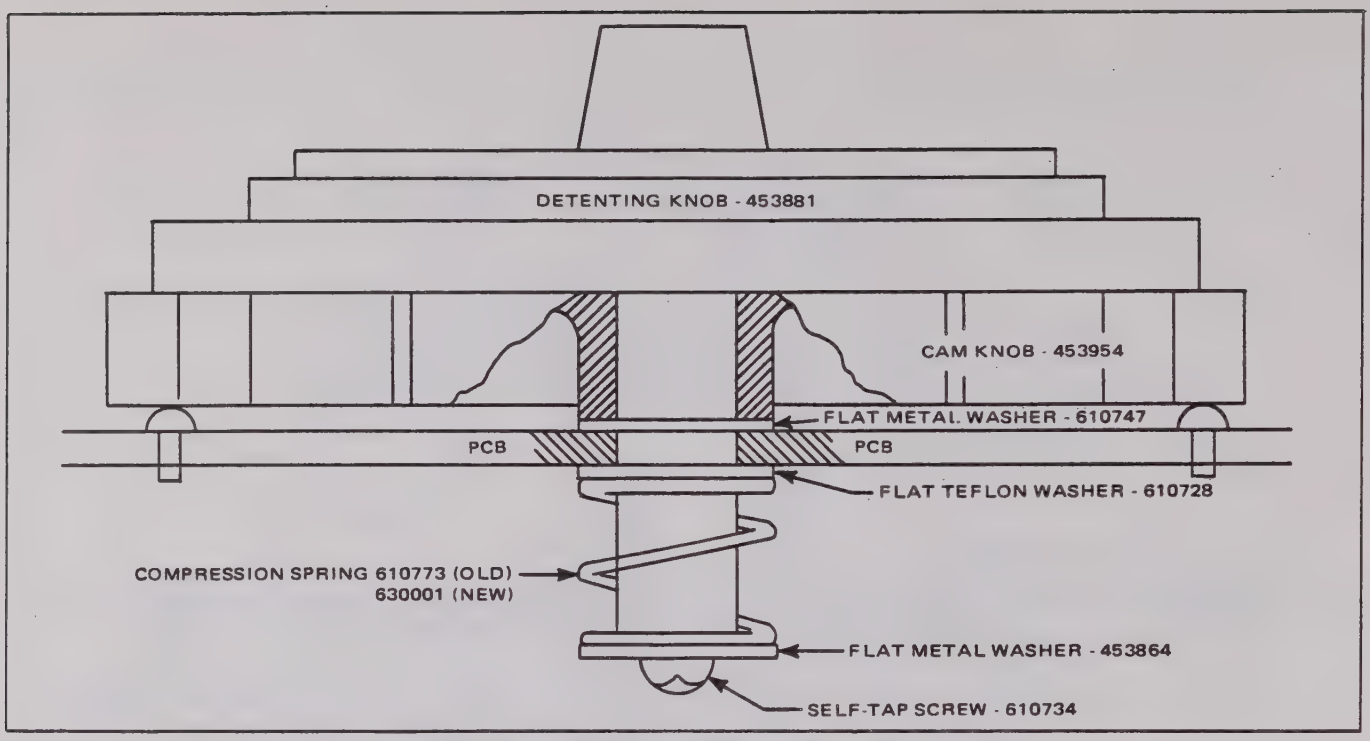


Figure 3.6 - 2000 (A) Revision E Switch Profile Drawing

3.7.6 In approximately Jan '77, the cam knob for the 2000 Danameter changed color from black to gray. This change primarily indicates that the material dimension was modified to eliminate the flat metal washer on top of the PCB, previously required. There are certain gray cam knobs that still have the flat metal washer due to the material composition.

3.8 DANAMETER SWITCH PROFILE (2100).

3.8.1 Model 2100 production started about the same time as the 2000 Rev. E, which uses the same switch profile, except that the cam knob is white and has different switch combinations. See Figure 3.7.

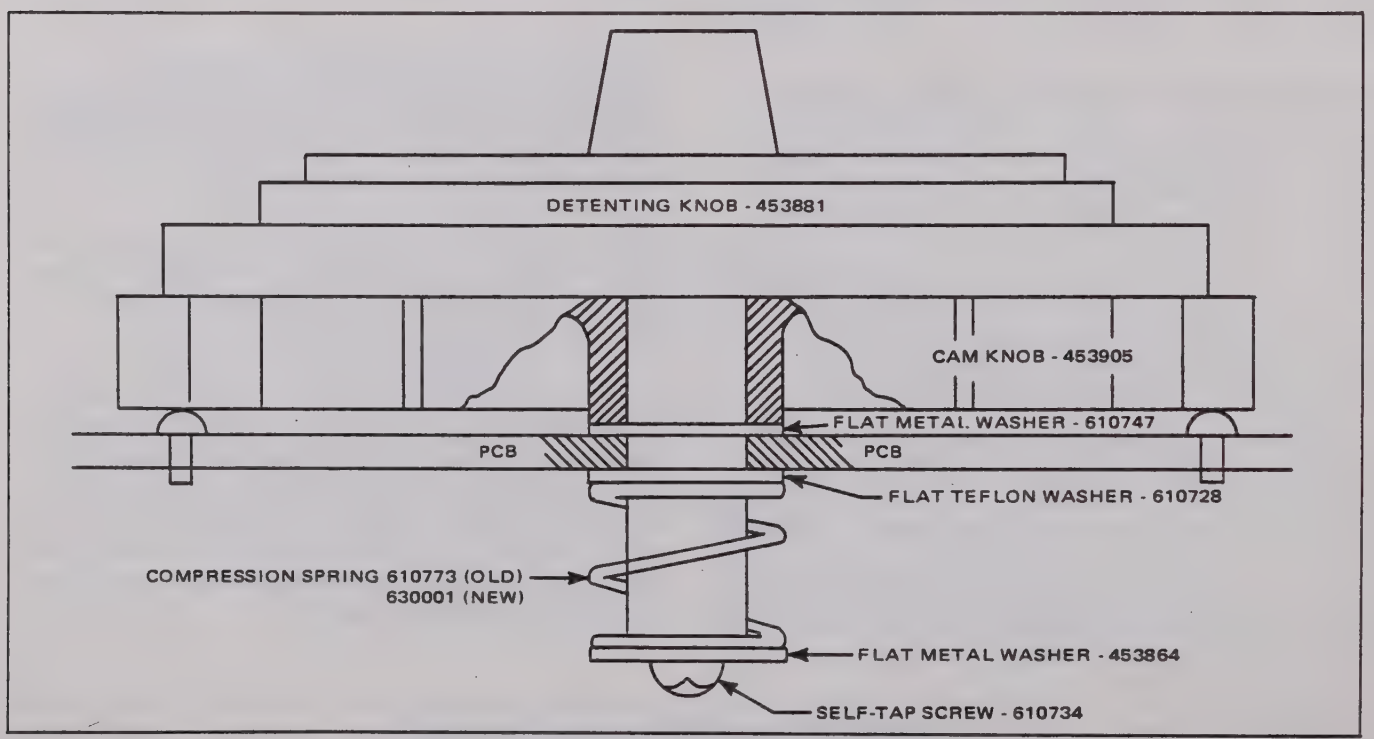


Figure 3.7 - 2100 (A) Switch Profile Drawing

3.9 DANAMETER NOTES AND PRECAUTIONS.

3.9.1 The purpose of this information is to insure that the switch will be re-assembled with the proper parts orientation when disassembly must be performed. Customer repair/cal facilities that have large inventories of Model 2000 (A) and/or 2100 (A)'s from different production periods must be conscious of the different switch profiles and that interchangeability cannot be accomplished.

3.9.2 Table 6.2 is a checkerboard of the switch combinations for the various ranges per function for the Model 2000, Revision B and C, meters.

3.9.3 Table 6.5 is a checkerboard of the switch combinations for the various ranges per function for the Model 2000 (A), Revision E to L (present). If this generation of meter has Option 03, reference zener, in place of the standard reference cell; Switch S35 is disabled by the addition of jumper, W1.

3.9.4 Table 6.9 is a checker board of the switch combinations for the various ranges per function for the Model 2100 (A), all revisions, A to H.

3.9.5 When a visual inspection of the switch is required, the reference cell should carefully be removed while the switch is in the "off" position to prevent damage to the analog chip and to prevent accidental shorting of the reference cell when removing it from its connector/holder.

3.9.6 When the reference cell is removed, a visual check should be made to determine if the contact surfaces of the reference cell have a thin, but visable, film of Red Cramolin TM paste which is an anti-corrosive, lubricant applied to prevent mechanical contact resistance errors. The reference cell should be stored in a relatively safe place, free of dust, humidity, elevated temperatures, and corrosive solvents, until it is to be re-installed in the meter.

3.9.7 When a visual inspection of Function (Range) switch reveals a bent, broken, or arced spring contact, a check should be made to see if the spring contact "(etched) pad" surface is arced or pitted. This usually occurs on a signal control switch when the meter is misused but sometimes occurs if a spring switch fails due to metal fatigue. The spring switch contacts can be replaced in the field by following the recommended procedure and exercising detailed soldering skills. Badly arced or pitted "pads" have been replaced, at the factory, with some degree of success, but require all the skills or a heart surgeon and is not recommended. The recommended procedure is to return the unit to the factory for repair.

3.9.8 Visual inspection of the spring switch contact pad surfaces should again reveal a thin, but visable, film of red Cramolin paste, which should not be removed. This is (re) applied at the factory or service centers with a camel hair (fine grade) brush which will not leave foreign matter to contaminate switch connections, which could happen if the paste were applied with a cotton swab, etc.

3.9.9 The digital chip, 7104 (A) P/N 230179, is extremely vulnerable to static charges, which can destroy internal functions. When a replacement chip is sent from the factory, it will be mounted in a conductive foam, effectively shorting the chip pins together. The same purpose can be accomplished by covering a styrefoam block with aluminum foil and mounting the digital chip accordingly. This procedure is recommended for shipping, carrying, or storing the digital chip, especially where high static charges can occur, such as carpeted areas, low humidity conditions associated with cold winter weather, etc. The digital chip is soldered to the PCB assembly, P/N 403767 (2000) or 403849 (2100), where static charges have no damaging effects. Should the digital chip be suspect as to the meter malfunction, great care should be exercised in removing it, just in case the chip is still operable.

3.9.10 A low wattage soldering iron should be used to desolder the digital chip to avoid destruction due to extreme heat. The digital chip should never be de-soldered with the meter "in operation" even with a soldering iron that has the "common" removed (sometimes used to (de) solder with circuits under power). A soldering "GUN" should never be used.

SECTION 4 BASIC OPERATION CONCEPTS

4.1 POWER AND CURRENT CONSUMPTION.

4.1.1 The first consideration in analyzing a Danameter malfunction of any production generation is that the voltage from the battery is present on pin 19 of the analog chip, (pin 25, digital chip) referenced to pin 4, analog chip, (pin 27, digital chip). See Figure 4.1.

4.1.2 The 9V battery used to provide operating voltages for the Danameters have very little current drain under normal operating conditions, as shown in Figure 4.2.

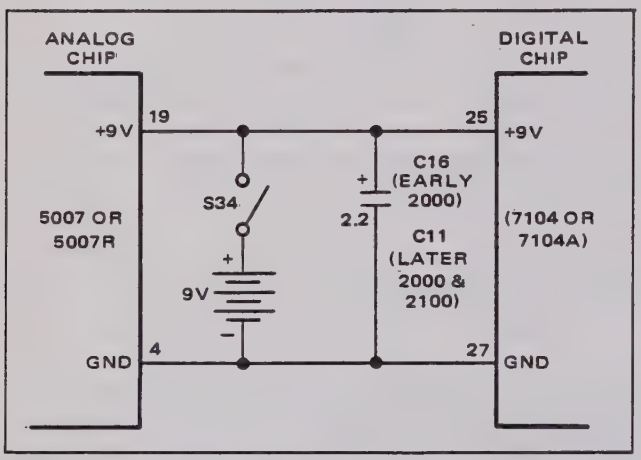


Figure 4.1 - Danameter Battery Interconnection Diagram

4.1.3 The battery is capable of providing some measure of operating potential even when the voltage has dropped to 5 volts, but as this would cause a "Test" reading below 600, a fresh battery should be installed, as recommended in the Danameter manuals.

4.1.4 Table 4.1 shows the resultant effects of the 9 volt battery as it relates to the –(9V) supply voltage and the liquid crystal display readout.

4.1.5 If a new 9 volt battery derates to 6-7 volts after a short period of operation it indicates a loading condition caused by a leaky/shorted capacitor (C16 or C11), analog chip, or digital chip.

4.2 CLOCK CIRCUIT.

4.2.1 The second consideration is that the clock circuit on the digital chip is operating within its design parameters. See Figure 4.3.

4.2.2 The R/C values of R16 (750KΩ) and C6 (62 pf) produce an 8 to 10 KHz clock pulse, at pin 28, approximately 5V p-p riding on a 4.5V d-c level, as shown in Waveform A. Pin 31 of the digital chip produces a differentiated waveform of 4V p-p as shown in Waveform B. Pin 30 produces a 5V p-p waveform on a 4.5V dc level as shown in

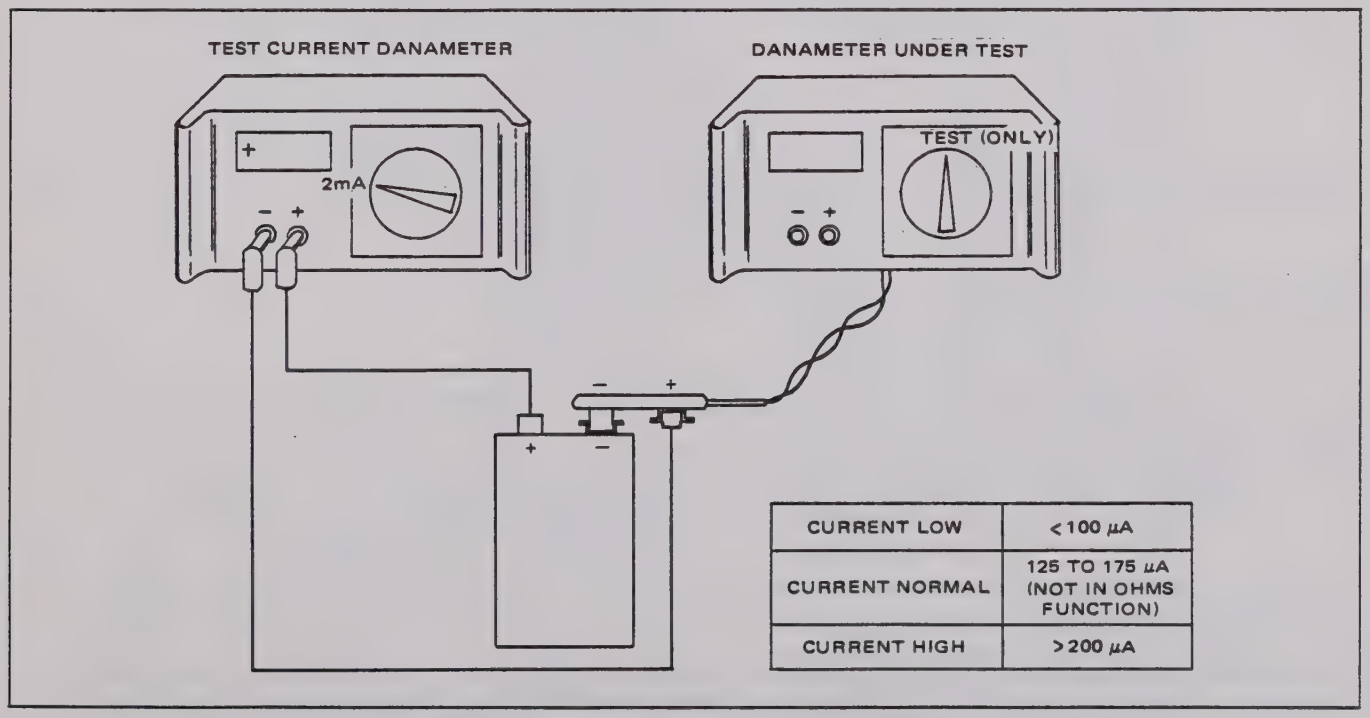


Figure 4.2 - Danameter Current Test Set-up Diagram

Table 4.1 - Battery Voltage Vs. LCD Readout

9V Battery	-(9V) Supply Voltage	LCD Readout
+9.5 VDC	–8.2 VDC	Display sharp, fast response
+9.0 VDC	–7.7 VDC	Display sharp, fast response
+8.0 VDC	–6.6 VDC	Display sharp, normal response
+7.0 VDC	–5.6 VDC	Display clear, medium response
+6.0 VDC	–4.6 VDC	Display becoming faint, but readable; slow response
+5.0 VDC	–3.6 VDC	Display becoming fainter, but readable; slower response
+4.0 VDC	–2.6 VDC	Display DIM, slower response; characters may lose segments
+3.0 VDC	–1.3 VDC	Display blank

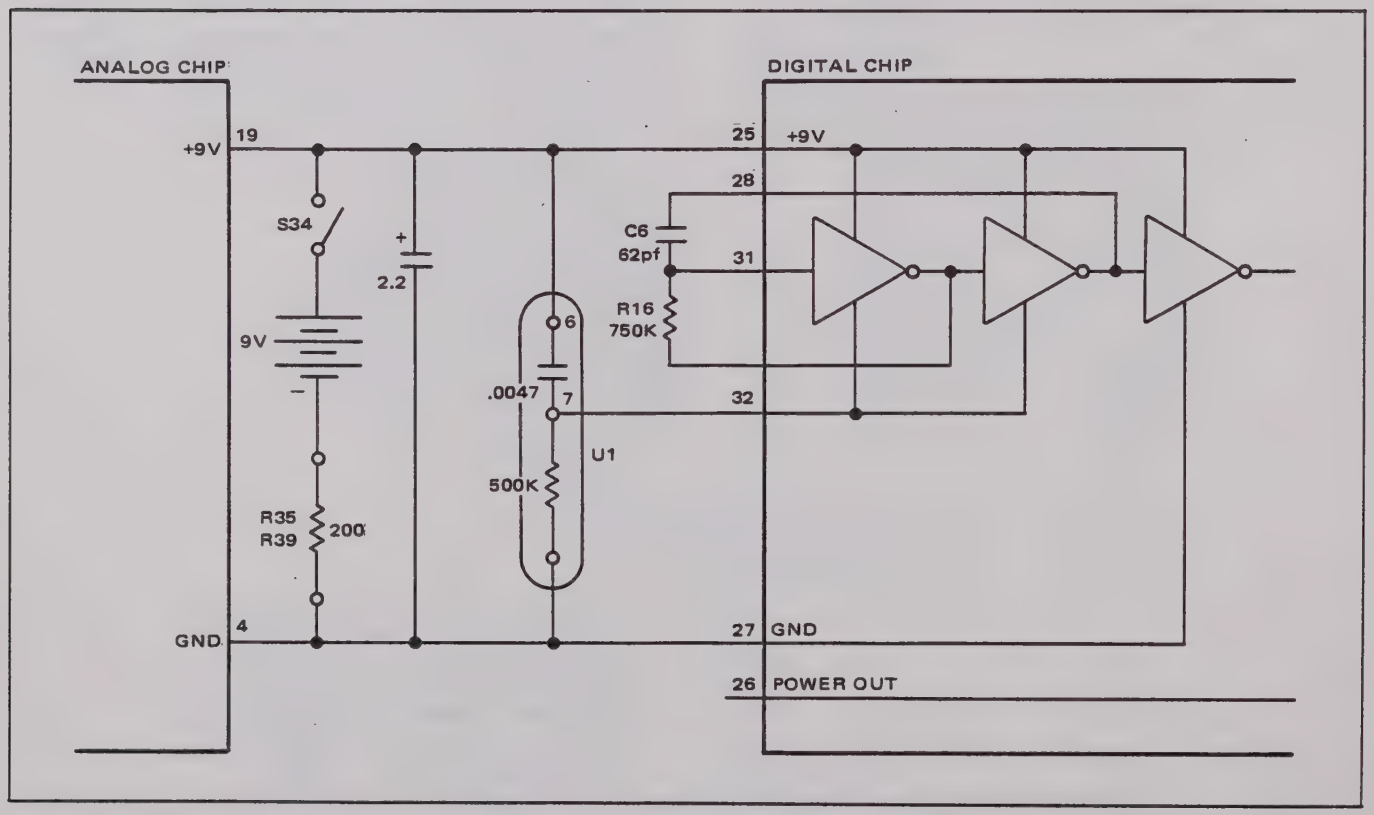


Figure 4.3 - Digital Clock Circuit

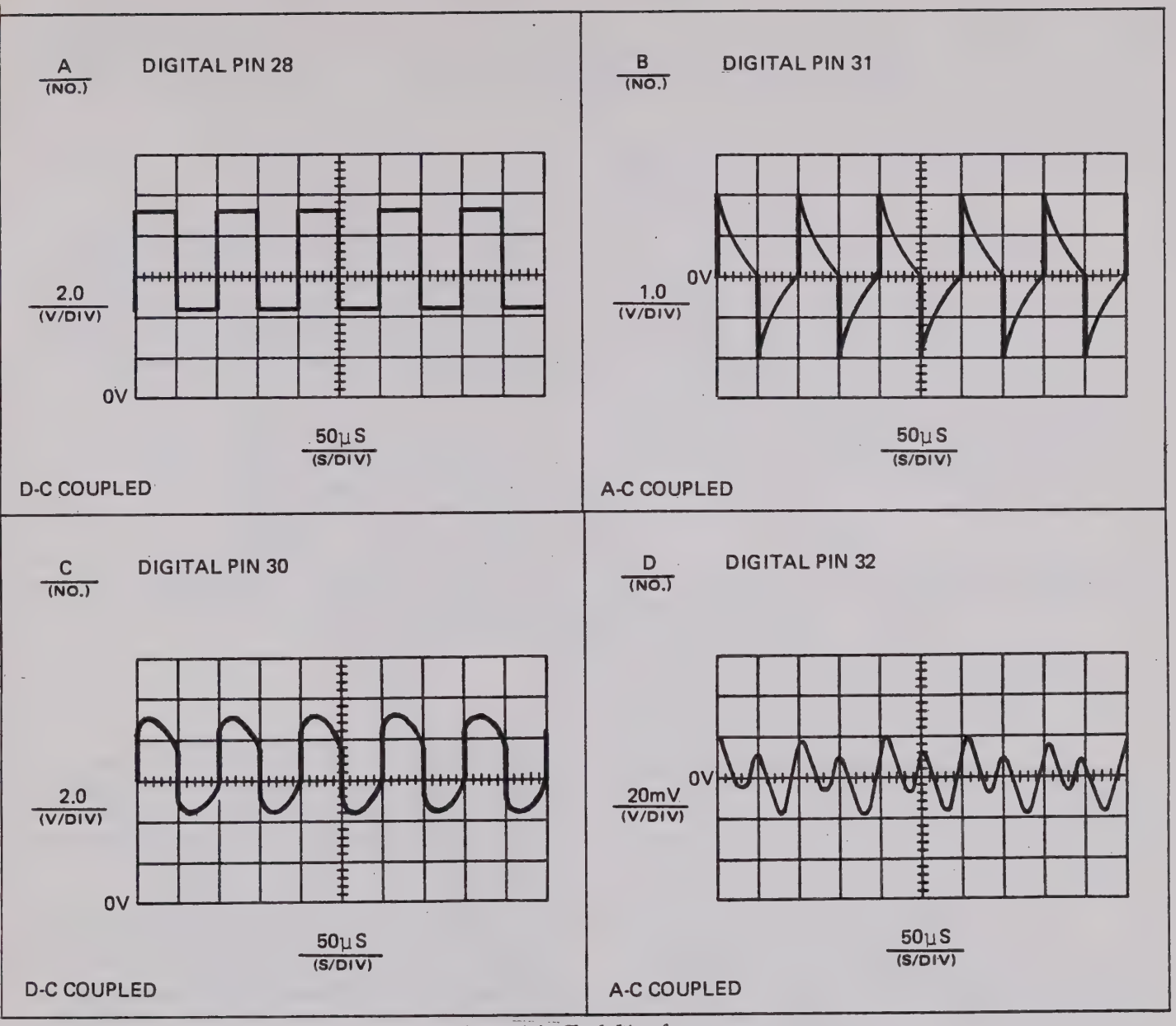


Figure 4.4 - Clock Waveforms

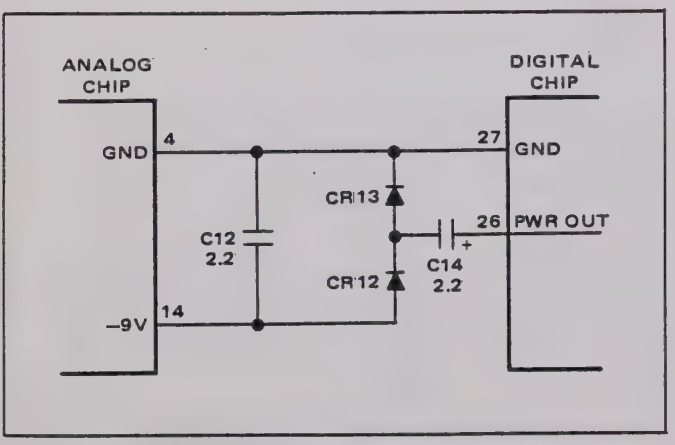


Figure 4.5 - Voltage Diameter Circuit

Waveform C. Pin 32 produces a 40 mV p-p waveform on a 4.25V dc level as shown in Waveform D. See Figure 4.4.

4.3 NEGATIVE POWER SUPPLY.

4.3.1 Pin 26 of the digital chip produces a square wave output, at 8 to 10 KHz, of 9V p-p, referenced to ground, labeled "power out" as shown in Waveform A. See Figure 4.5 and 4.6.

4.3.2 This circuit is a voltage inverter to provide the –9V (approx) necessary to power the analog chip current regulators. The capacitor, C14, couples the "power out" signal to CR12 and 13 as shown in Waveform B. The peaks of the power out signal are clamped by a diode drop, CR13, above

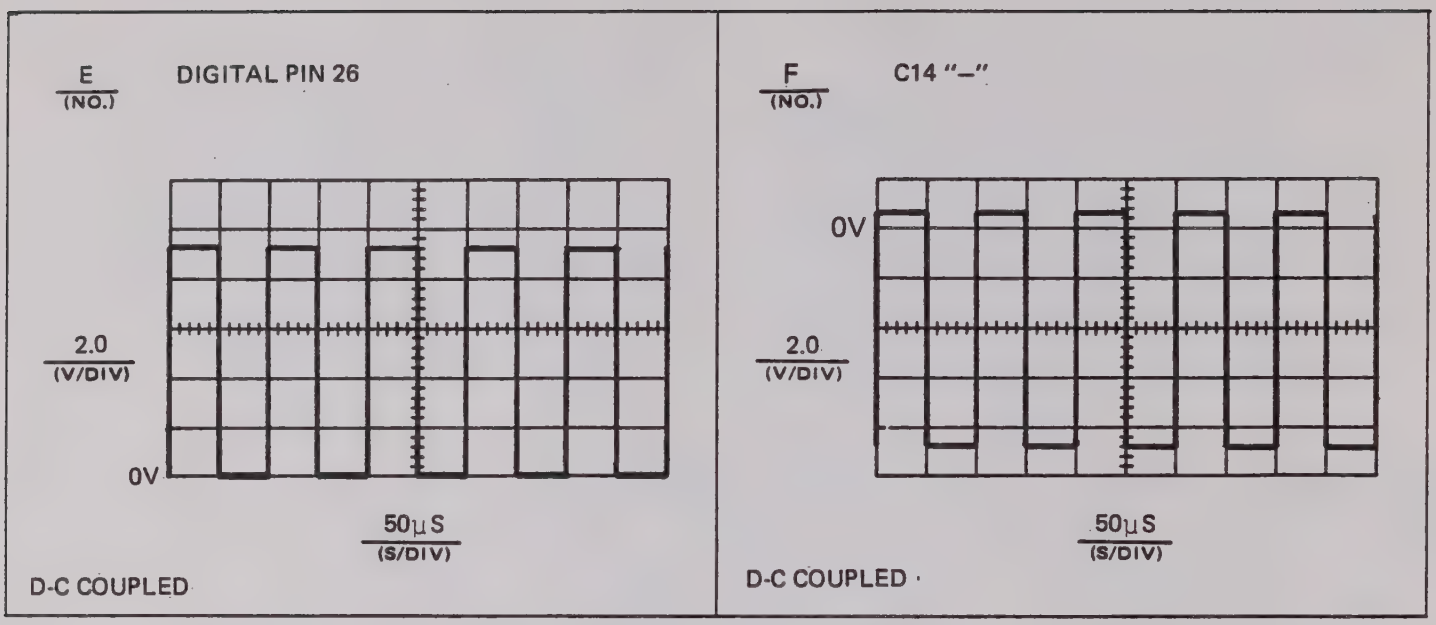


Figure 4.6 - Negative Power Supply Waveforms

ground. The remaining portion of the clock waveform is allowed to seek its level below ground to be stored/filtered by C12 and ultimately to the –9V connection on the analog chip, pin 14. Without the +9V, there can be no clock, without which there can be no –9V for the analog chip.

4.3.3 The analog chip should be replaced with a new device or one in known good condition first, because (1) it it easily removed/installed from its connector and (2) because through misuse or failure, it is exposed to voltages and currents that, externally, could cause it to malfunction.

4.3.4 If the correct power supply (+9V) still cannot be obtained, the digital chip should be replaced. This requires careful de-soldering practices to prevent heat damage to the chip (in case the chip is good), the through-plated terminations, and the etches.

4.3.5 Power problems that still persist must be caused by a failure of a discrete component such as resistors, resistor-networks, capacitors, diodes, or switch elements, which can be located by a thorough visual inspection and by conventional resistance checks with a Danameter or Volt-Ohmmeter.

SECTION 5 TIMING & CONTROL SIGNALS

5.1 GENERAL DESCRIPTION.

5.1.1 The Danameters have control signals, which, if observed with an oscilloscope, do not reveal the direct timing relationship of the digitizing sequence between the analog and digital chip. There are four distinct time periods, controlled by the 8 to 10 KHz clock signal from the digital chip, which will be 100 to 125 mSec in duration, due to the clock frequency. See Figure 5.1.

5.2 SIGNAL INTEGRATE (3K).

5.2.1 The analog chip pin 7 (digital pin 33) counts from 3000 to 3999. This is the signal integrate time period when the input signal has been scaled, filtered or converted by the isolator into a current to be applied to the integration capacitor (between pin 7 and 8 of the analog chip), called 3K. The following waveforms depict a 3K (signal integrate) for 0 input, half scale (1000 counts) and full scale (1999 counts). See Figure 5.2.

5.3 REFERENCE INTEGRATE (IR).

5.3.1 The analog chip pin 6 (digital pin 24), called IR, is the reference integration period that counts from 0 to 1999 (FS). When the counter is reset to 0 in the digital chip, the first 32 counts are detected and the counter is again reset. This is used to mask switching transients that could cause a false zero detect, with an input signal at or near zero. 32 counts x clock frequency (100 μsec) will produce a 3.2 millisecond signal (0 input). The following waveforms will be for 0 input, half scale, and full scale. See Figure 5.3.

5.4 REFERENCE INTEGRATION CAPACITOR (CI).

5.4.1 The analog chip pin 8, called CI, is the integration amplifier input from the integration capacitor (between pin 7 and 8). This is the waveform of the integration from 0 to 1999 counts. Zero detect must occur during this period for the meter to obtain a valid reading. Reaching zero detect after 1999 counts are accumulated is detected as overload. The IR signal will be low for the length of the slope for this signal as shown in the following 3 waveforms for O_{in}, HS, and FS. See Figure 5.4.

5.5 ZERO CROSSING (ND).

5.5.1 The analog chip pin 9 (digital pin 23) is called ND (null detect) which occurs when zero crossing is detected. This line signals the counter in the digital chip to transfer the decade quantity into the latches, decoders and drivers for the LCD readout. The signal goes low at the beginning of signal integrate and goes high at zero crossing. The following waveforms depict the O_{in}, HS, and FS signals. See Figure 5.5.

5.6 WAVEFORMS FOR TIMING AND CONTROL.

5.6.1 The true time relationship can be observed if the oscilloscope can be externally triggered ("–") using the 3K (signal integrate) signal. This line could be excessively loaded and could result in non-linearity meter operation and waveforms. See Figure 5.6.

> **NOTE**
>
> The waveforms for Figure 5.6 are for a full scale signal (≈1900 digits).

5.7 TEST INSTRUMENT MEASUREMENT CONSIDERATIONS.

5.7.1 Applying test equipment directly to the analog chip pins can have less than desirable effects when looking for specific values of D-C voltages or oscilloscope waveforms due to low input impedance and capacitive coupling of the test leads.

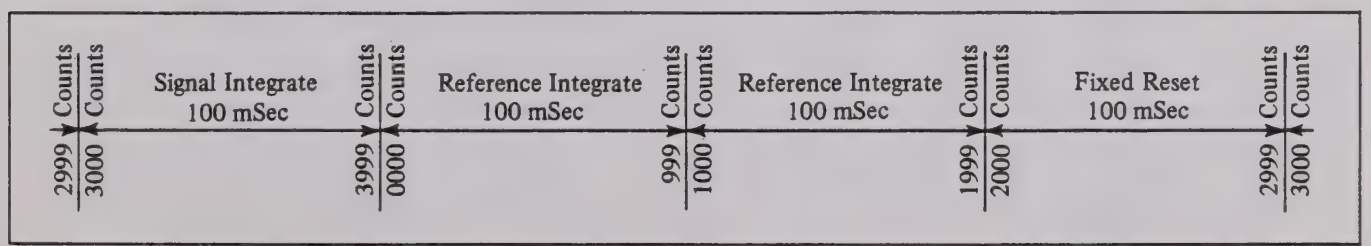
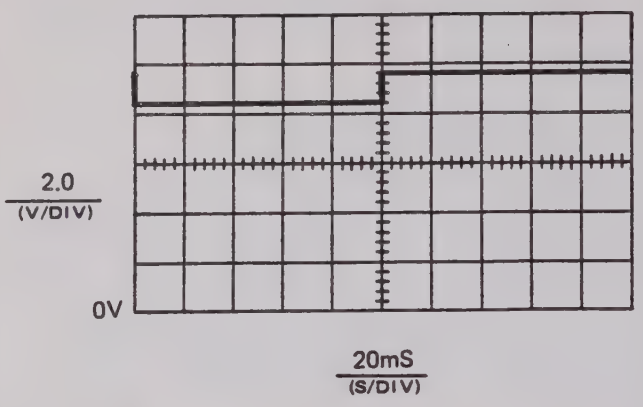


Figure 5.1 - Danameter Control Signals

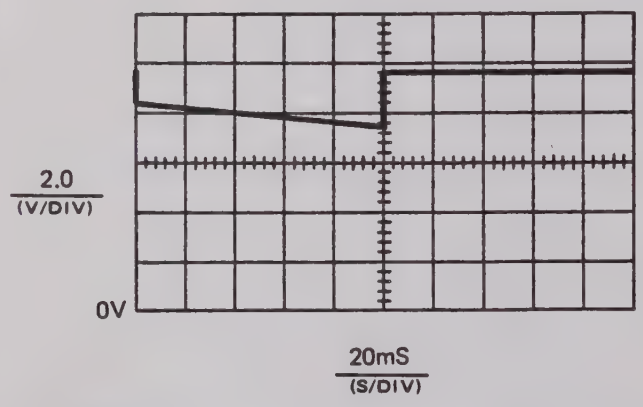
A1 (NO.) SIGNAL INPUT - 0V

ANALOG CHIP, PIN 7 - $\overline{3K}$



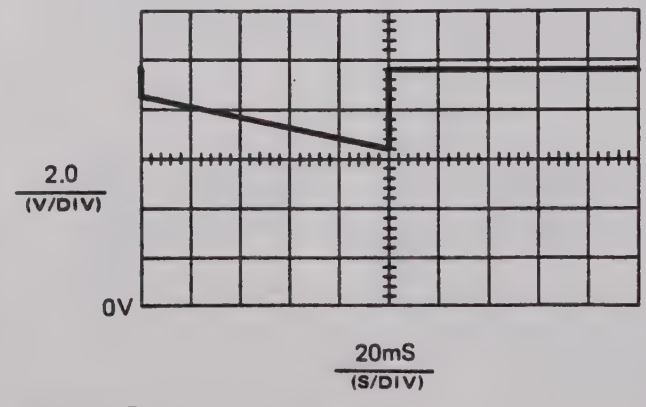
D-C COUPLED

A2 (NO.) SIGNAL INPUT 1.000 (HS)



D-C COUPLED

A3 (NO.) SIGNAL INPUT 1.999 (FS)

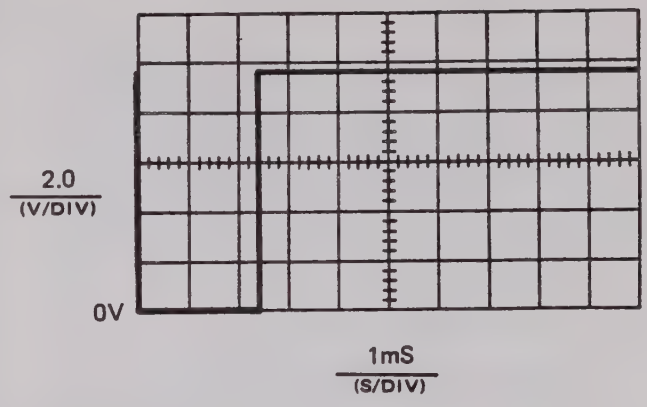


D-C COUPLED

Figure 5.2 - 3K, Signal Integrate

B1 (NO.) $\overline{IR}$ (0 IN)

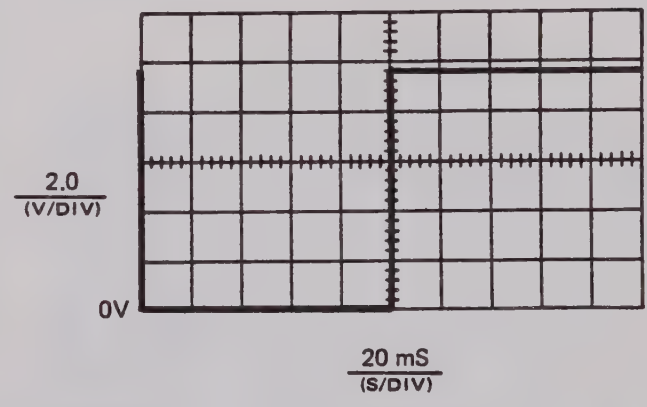
ANALOG PIN 6



D-C COUPLED

B2 (NO.) $\overline{IR}$ (HS)

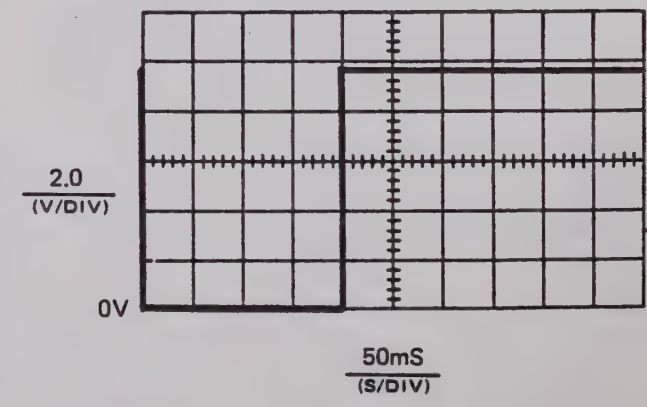
ANALOG PIN 6



D-C COUPLED

B3 (NO.) $\overline{IR}$ (F/S)

ANALOG PIN 6

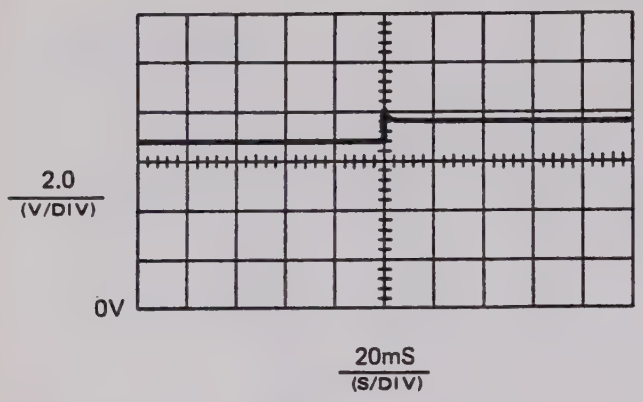


D-C COUPLED

Figure 5.3 - IR, Reference Integrate

C1 (NO.) 0 IN

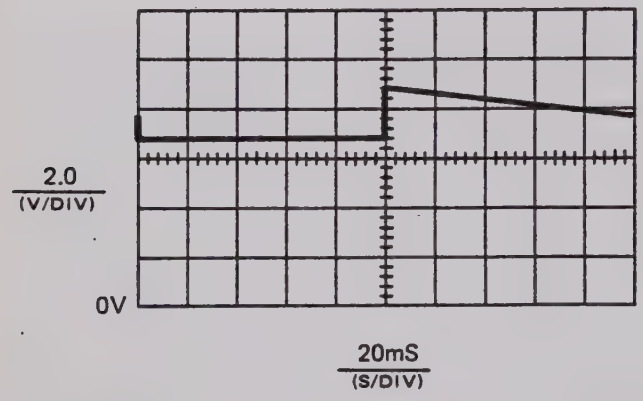
ANALOG PIN 8



D-C COUPLED

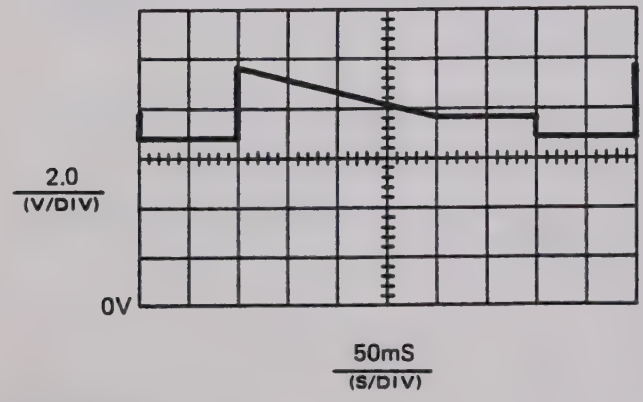
C2 (NO.) HS

ANALOG PIN 8



D-C COUPLED

C3 (NO.)

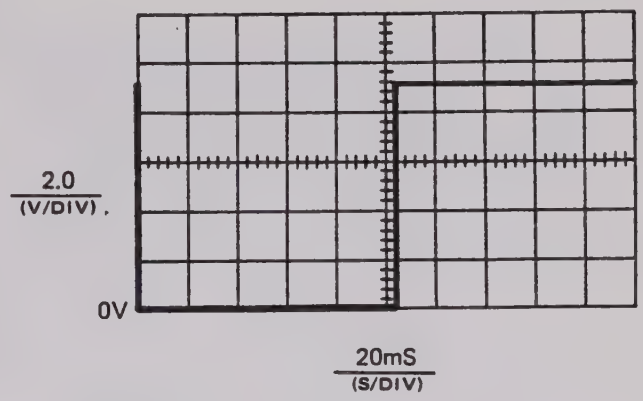


D-C COUPLED

Figure 5.4 - CI Reference Integrate Capacitor

D1 (NO.) 0 IN

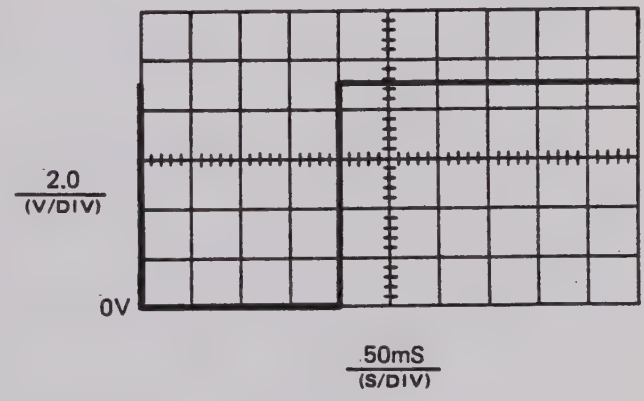
ANALOG PIN 9



D-C COUPLED

D2 (NO.) HS

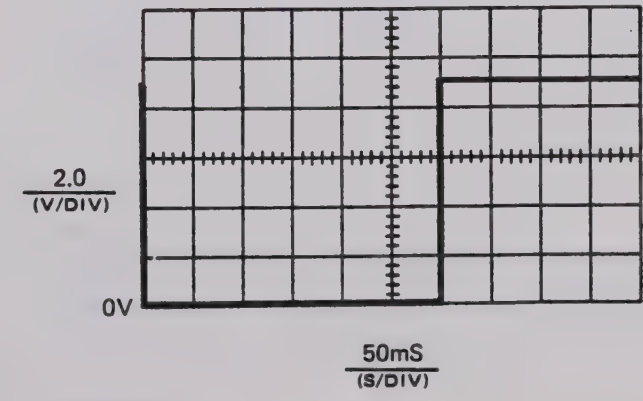
ANALOG PIN 9



D-C COUPLED

D3 (NO.) FS

ANALOG PIN 9



D-C COUPLED

Figure 5.5 - ND, Null Detect

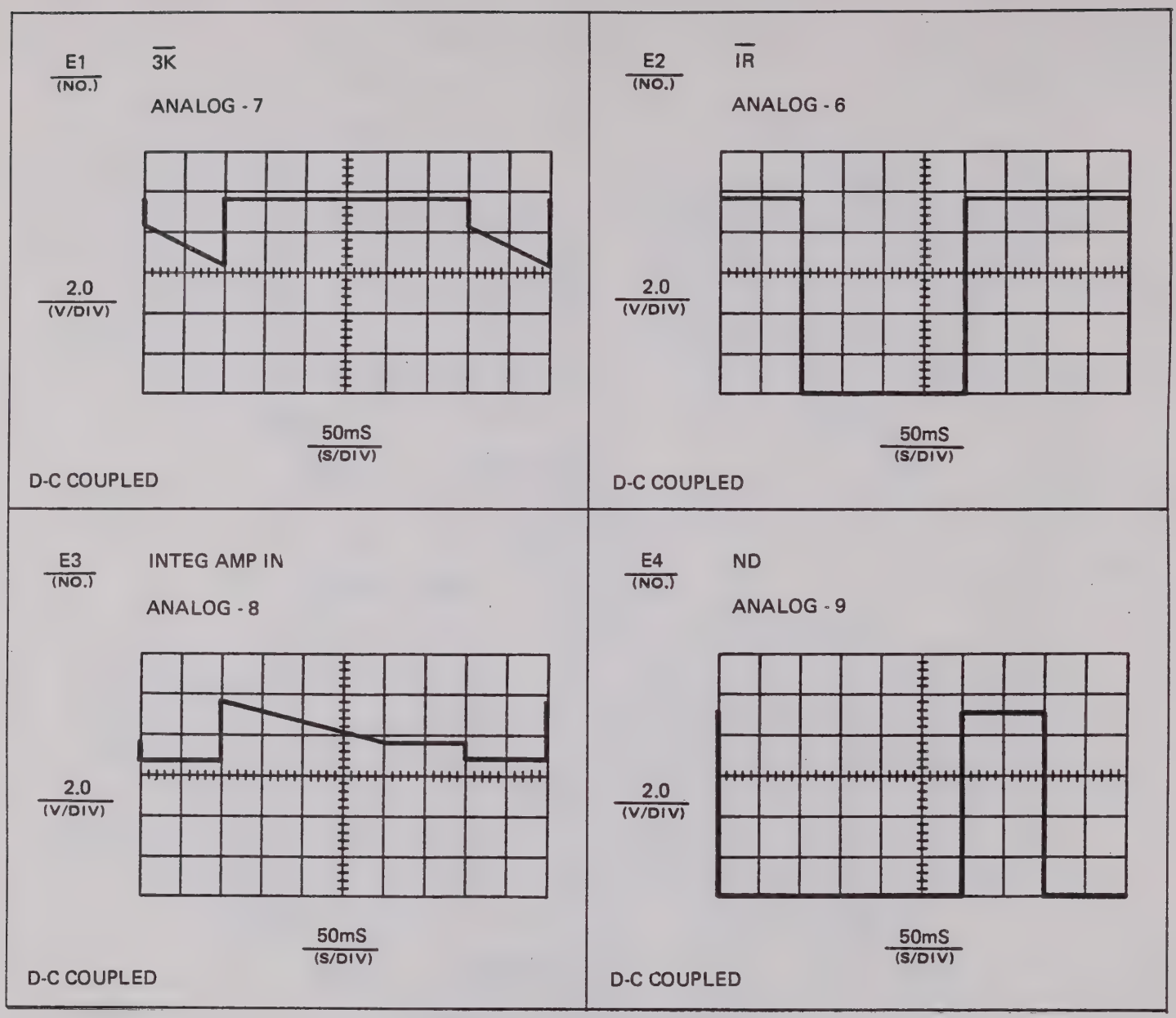


Figure 5.6 - True Time Relationship

5.7.2 DC voltage measurements should be made with a meter having a minimum input resistance of 10MΩ. DC values contained in this document were obtained with a Dana Model 4700A, integrating type DMM, with the following specifications for the ranges involved.

Range	Accuracy	Input Resistance
0.1 VDC range	± 0.02% reading +0.03% full scale	1000MΩ
1.0 VDC range	± 0.01% reading +0.01% full scale	1000MΩ
10 VDC range	± 0.01% reading +0.01% full scale	10MΩ

5.7.3 Oscilloscope having a minimum input resistance of 1MΩ in parallel with a 20 pfd capacitor and using a X10 input test probe.

5.7.4 Waveforms in this document were obtained with a Tektronix 454 using the X10 input test probe.

5.7.5 DC current measurements were made with a Dana-meter 2000 (Rev. E).

SECTION 6 TROUBLESHOOTING

6.1 DESCRIPTION.

6.1.1 This section contains information and test data for the following production configurations of Danameters:

1. 2000 Danameter (Revision B&C) 5007 Analog Chip and Reference Cell

2a. 2000 (A) Danameter (Revision E to L) 5007R Analog Chip and Reference Cell

2b. 2000 (A) Danameter (Revision E to L) 5007R Analog Chip and Reference Zener

3. 2100 (A) Danameter (Revision A to H) 4007R Analog Chip and Reference Zener.

6.2 CALIBRATION CHECK DEFINITION.

6.2.1 The first part of each section contains a calibration check table to determine if the displayed results are within the published specification tolerances for all functions and ranges. This is to be used to determine if re-calibration is required or if a malfunction is present for a given function per range.

6.3 SWITCH CLOSURE CHART DEFINITIONS.

6.3.1 The second part is a Switch Closure chart to indicate which switches are energized for a specific function and range. This can also serve to identify malfunctions related to switch contact failures when, for example, a certain switch is common to function and/or range problems.

6.4 DC VOLTAGE AND WAVEFORM CHART.

6.4.1 The third part is a DC Voltage Chart of the Analog IC for various functions and ranges. This is a random test of each function to determine if the voltage at an analog pin is present or within a acceptable tolerance (typically ± 5%) of the recorded DC voltages. No test involves input voltages greater than the 20 range (DCV and ACV) to provide a safe environment while troubleshooting is being performed. The 200 and 1000 (DCV and ACV) ranges are scale attenuation functions of peripheral components and switches.

NOTE

In some instances, DC voltages can be measured; but, because of the loading effects on the meter circuitry, the display indicates "OL" (overload). These are noted on the chart, in some cases. A numbered diamond ◇1◇ indicates that DC voltage measurements will serve no useful purpose. These are oscilloscope measurements (waveforms) of the timing and control signals of the instrument. The fourth part is the waveforms of the analog IC timing and control signals for given functions and ranges, indicated by the numbered diamond.

6.5 FUNCTIONAL SCHEMATIC DIAGRAM.

6.5.1 The fourth part is a functional schematic of the complete instrument. The analog and digital chips contain functional block diagrams to assist repair/calibration personnel for troubleshooting and gain a better understanding of the analog and digital operation and circuitry.

6.6 ASSEMBLY DRAWINGS.

6.6.1 The fifth part contains the assembly drawings of the main circuit PCB (top and bottom) and an outline of the switch contacts. The switches are numbered to correspond to those on the switch closure chart. Switches that are not numbered are not used for any function or range.

Table 6.1 - 2000 Calibration Check (Rev. B&C)

Danameter Switch	Standard		Danameter Readout	Acceptable Range
	Type	Output		
2 VDC	DC	0	.000	(Must Read Zero)
		+.1	+.100	+.099 to +.101
		−.1	−.100	−.099 to −.101
		+1	+1.000	+.994 to +1.006
		−1	−1.000	−.994 to −1.006
		+1.9	+1.900	+1.890 to +1.910
		−1.9	−1.900	−1.890 to −1.910
20 VDC		+10V	+10.00	+9.92 to +10.08
200 VDC		+100V	+100.0	+99.2 to +100.8
1 K VDC		+1000V	+1000	+992 to +1008
Reduce Standard Output and Remove from Meter Input				
2 VAC	AC	0	.000	.000 to .002
		.1V @ 1 KHz	.100	.097 to .103
		1V @ 1 KHz	1.000	.973 to 1.027
		1.9V @ 1 KHz	1.900	1.850 to 1.950
20 VAC		19V @ 1 KHz	19.00	18.50 to 19.50
200 VAC		190V @ 1 KHz	190.0	185.0 to 195.0
1 K VAC		700V @ 1 KHz	700	681 to 719
Reduce Standard Output and Remove from Meter Input				
200Ω	Resistance	0	00.0	00.0 to 00.2
		100Ω	100.0	96.3 to 103.7
20KΩ		10KΩ	10.00	9.84 to 10.16
2MΩ		1MΩ	1.000	.964 to 1.036
200MΩ		100MΩ	100.0	919 to 108.1
Remove Standard from Meter Input				
20μA	Current	+19μA	+19.00	+18.60 to +19.40
2mA		+1.9mA	+1.900	+1.860 to +1.940
200mA		+190mA	+190.0	+186.0 to 194.0
2A		+1.9A	+1.900	+1.860 to +1.940
Reduce Standard Output and Remove from Meter Input				

Table 6.2 - Switch Closure Chart - Danameter Model 2000 (Rev. B & C)

SWITCH NOMENCLATURE	OFF	TEST	DCV 2	DCV 20	DCV 200	DCV 1000	ACV 2	ACV 20	ACV 200	ACV 1000	OHMS 200	OHMS 20K	OHMS 2M	OHMS 200M	CURRENT (DC) 20μA	CURRENT (DC) 2mA	CURRENT (DC) 200mA	CURRENT (DC) 2A	FUNCTION (RANGE) SWITCHES
DC INPUT TO RANGE ATTENUATOR			■	■	■	■													1
AC INPUT							■	■	■	■									2
1 mA CURRENT SOURCE											■								3
10μA CURRENT SOURCE												■							4
1μA CURRENT SOURCE													■						5
10 mA CURRENT SOURCE														■					6
10KΩ CURRENT SHUNT															■				7
100Ω CURRENT SHUNT																■			8
1Ω CURRENT SHUNT																	■		9
.1Ω CURRENT SHUNT																		■	10
9M/1M VOLTAGE DIVIDER (≈1 Vdc)		■																	11
DIRECT DCV INPUT			■																12
÷ 10 DCV INPUT				■															13
÷ 100 DCV INPUT					■														14
÷ 1000 DCV INPUT						■													15
DIRECT ACV INPUT							■												16
÷ 10 ACV INPUT								■											17
÷ 100 ACV INPUT									■										18
÷ 1000 ACV INPUT										■									19
OHMS CURRENT TO ISOLATOR											■	■	■	■					20
DC CURRENT TO ISOLATOR															■	■	■	■	21
AC CONVERTER OUTPUT TO ISOLATOR							■	■	■	■									22
PROTECTION CLAMP CKT							■	■	■	■	■					■	■	■	23
ISOLATOR INPUT FILTER		■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	24
AC CONVERTER ENABLE							■	■	■	■									25
ISOLATOR GAIN (AC)							■	■	■	■									26
ISOLATOR GAIN (CURRENT & KΩ)											■	■			■	■	■	■	27
POLARITY ENABLE (DCV)			■	■	■	■													28
POLARITY ENABLE (DC CURRENT)															■	■	■	■	29
ACV COMPENSATION + Vos							■	■	■	■									30
2 RNG DECIMAL POSITION			■				■						■			■		■	31
20 RNG DECIMAL POSITION				■				■				■			■				32
200 RNG DECIMAL POSITION					■				■		■			■			■		33
9V BATTERY ENABLE		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	34
1.35V REF. CELL ENABLE		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	35
DC (I, V, Ω) SIG. INPUT		■	■	■	■	■					■	■	■	■	■	■	■	■	36
OHMS AMP OUTPUT TO I RESISTORS											■	■	■	■					37

■ SWITCH CLOSURE

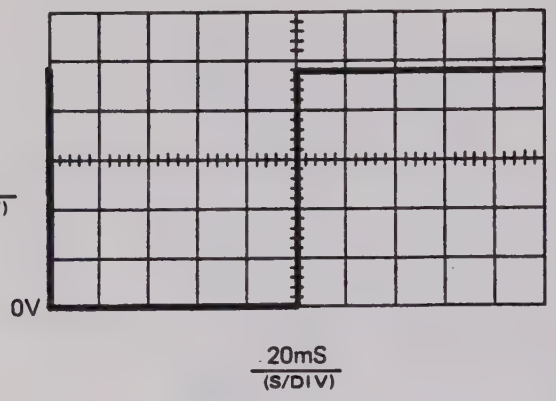
Table 6.3 - Danameter 2000 (Rev. B & C) Reference Cell

	TEST	DCV	ACV	OHMS	DC CURRENT	FUNCTION
	–	2	20 @ 1 KHz	20KΩ	2mA	RANGE
U4 PIN	955	–1.850	19.09	17.74	+1.806	READING
1	–.00013	–.00015	–.00015	–.00016	.0000	LO IN (ISO LO + IN)
2	–.00027	–.00017	–.00031	–.00028	+.00045	Gm 1 (ISO LO – IN)
3	+9.230 O/L	+9.20 O/L	+9.21 O/L	+9.13 O/L	+9.2 O/L	COMP 2 (ISO LO AMP)
4	–.0000	–.0000	–.0000	–.0000	–.0000	GND POWER SUPPLY
5	+9.488	+.0017	+9.437	+9.463	+9.459	POL LOGIC LEVEL
6	◇1◇	◇5◇				$\overline{IR}$ REF. INTEGRATE
7	◇2◇	◇6◇				$\overline{3K}$ SIG. INTEGRATE
8	◇3◇	◇7◇				C1 INTEGRATOR AMP IN
9	◇4◇	◇8◇				ND NULL DET OUT
10	+1.753	+1.780	+1.795	+1.032	+1.768	OHMS REF (AMP INPUT)
11	+1.987	+1.805	+1.795	+1.195	+1.810	OHMS OUT
12	–.600	–.000	+.775 ◇10◇	–.000	–.000	AC OUT (+ OUT)
13	–.000	–.000	–.000 ◇11◇	–.000	–.000	Gm 2 (AC – OUT)
14	–8.670	–8.610	–8.425	–8.558	–8.550	-9V POWER SUPPLY
15	+9.338	+9.310	+9.287	+9.275	+9.303	COMP + VO_S (AC CONV)
16	–.000	–.000	+.000 ◇12◇	–.000	–.000	AC CLAMP BIAS (AC "–" IN)
17	–.000	–.000	–.000 ◇9◇	+.000	–.000	AC IN (+ IN)
18	–.000	–.000	+9.77	+.000	–.000	AC ENABLE
19	+9.856	+9.830	+9.824	+9.824	+9.820	+9V POWER SUPPLY
20	+9.816	+9.800	+9.785	+9.784	+9.781	CLAMP (ISO HI INPUT)
21	+1.316	+1.318	+1.320	+1.319	+1.319	CO (INTEGRATOR CAP COMP.)
22	+1.312	+1.315	+1.316	+1.317	+1.314	BR (REF CELL/ZENER INPUT)
23	+1.314	+1.314	+1.314	+1.315	+1.311	RR (REFERENCE COMPENSATION)
24	+8.757	+8.725	+8.727	+8.721	+8.717	EVOS
25	+.979	–1.896	+.782	+.184	+.187	BSV (BOOTSTRAP AMP OUTPUT)
26	+9.23 O/L	+9.23 O/L	+9.20 O/L	+9.11 O/L	+9.2 O/L	COMP 1 (ISO HI AMP)
27	+.978	–1.897	+.765	+.182	+.185	Gm 0 (ISO HI – IN)
28	+.978	–1.897	+.755	+.182	+.168	HI IN (ISO HI + IN)

U1–14,+.702
U1–13,–.936
U1–3,+1.894

1 (NO.) $\overline{IR}$

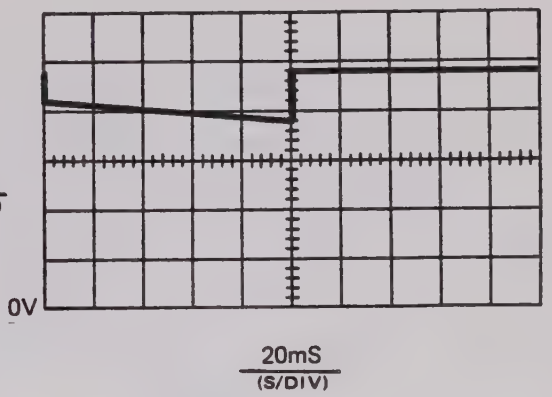
U1-6



D-C

2 (NO.) $\overline{3K}$

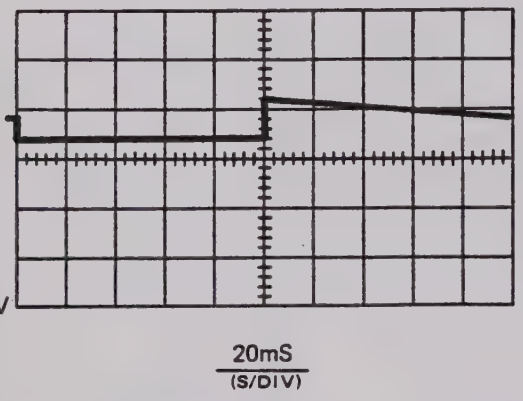
U1-7



D-C

3 (NO.) INTEG AMP IN

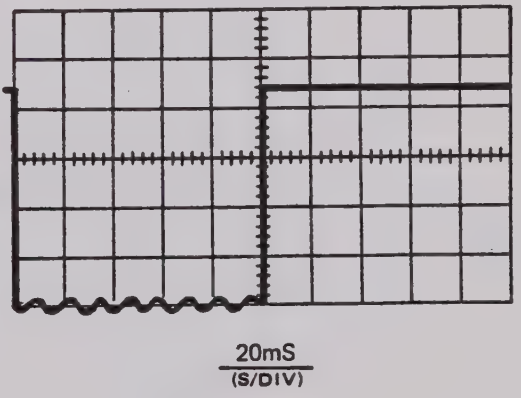
U1-8



D-C

4 (NO.) ND

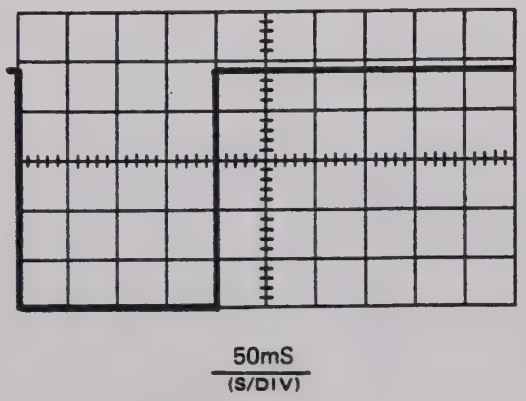
U1-9



D-C

5 (NO.) $\overline{IR}$

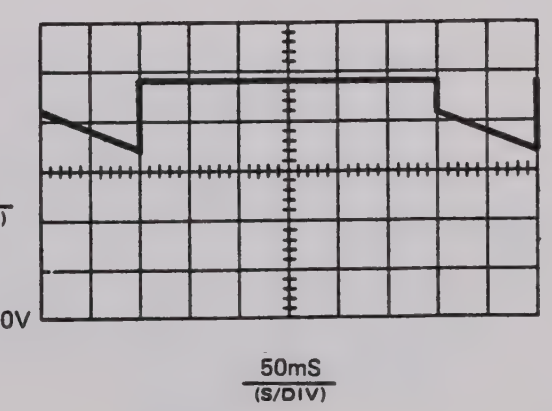
U1-6



D-C

6 (NO.) $\overline{3K}$

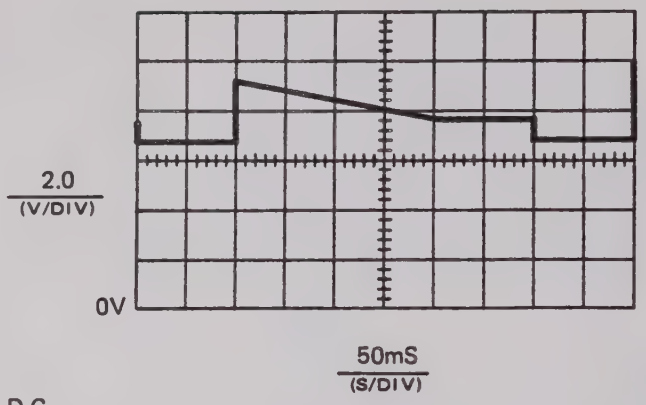
U1-7



D-C

7 (NO.) INTEG AMP IN

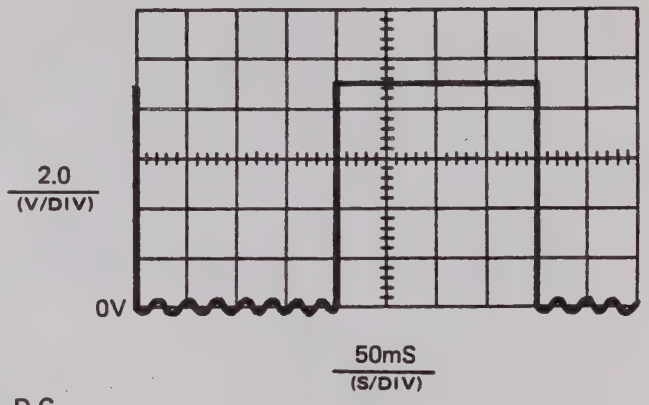
U1-8



D-C

8 (NO.) ND

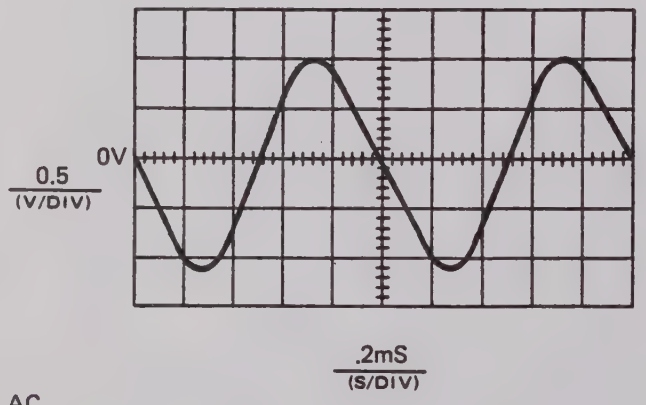
U1-9



D-C

9 (NO.) AC IN

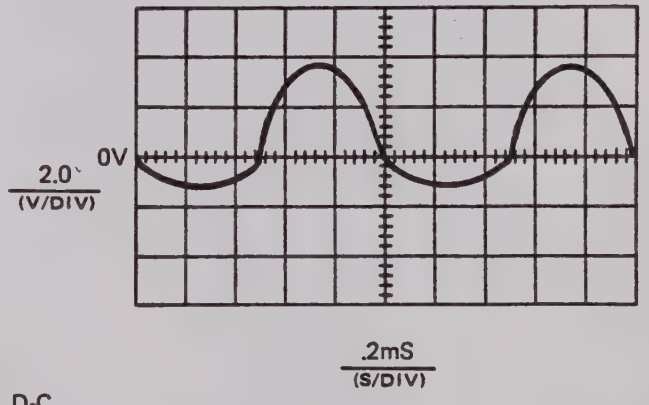
U1-17



AC

10 (NO.) AC OUT (+)

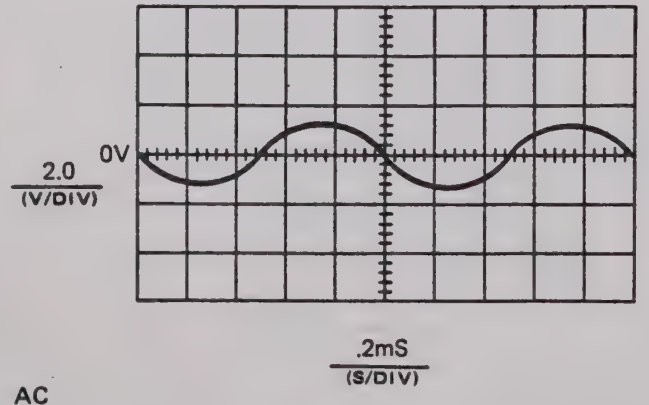
U1-12



D-C

11 (NO.) AC OUT (–)

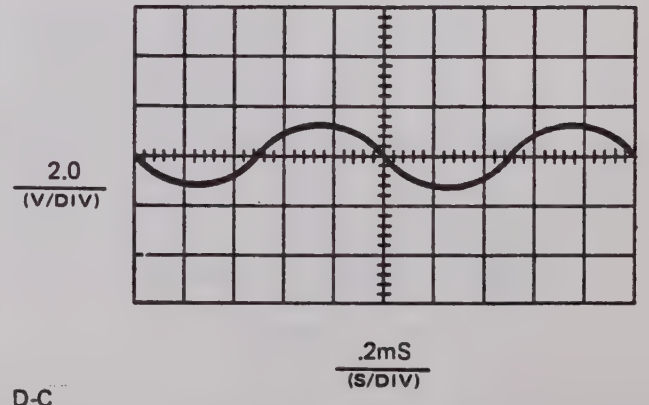
U1-13



AC

12 (NO.) AC CLAMP BIAS

U1-16



D-C

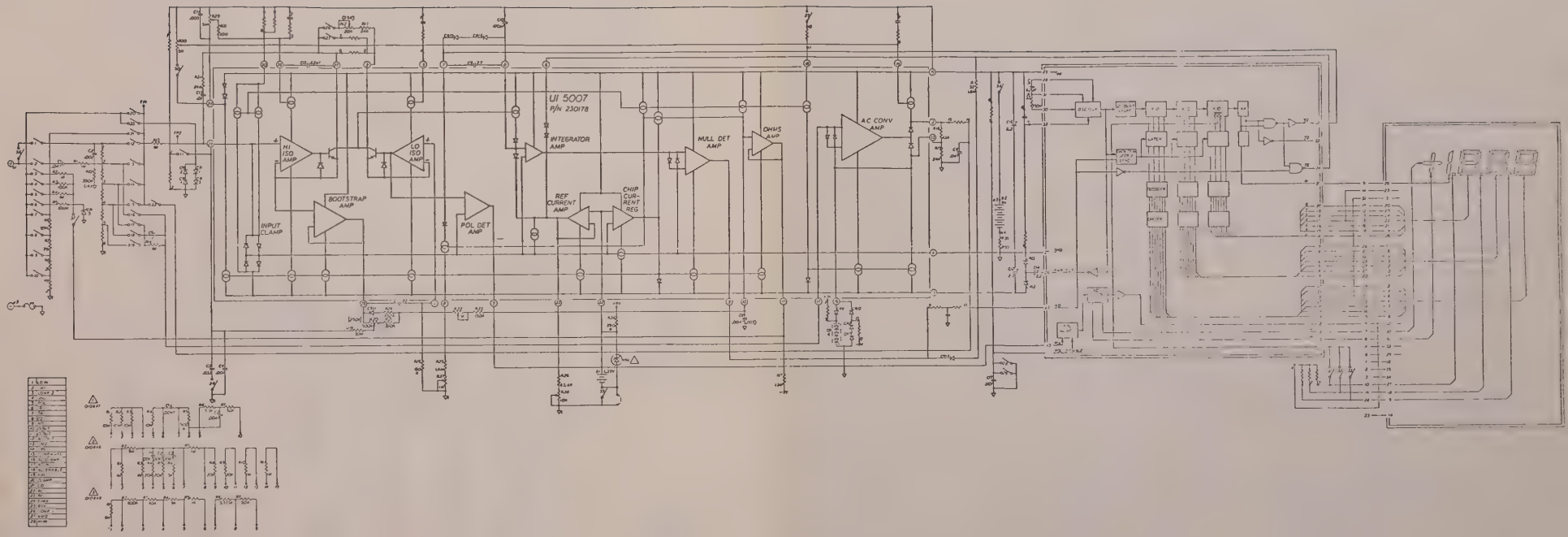


Figure 6.1 - Danameter Functional Schematic
2000 Danameter Rev. B & C

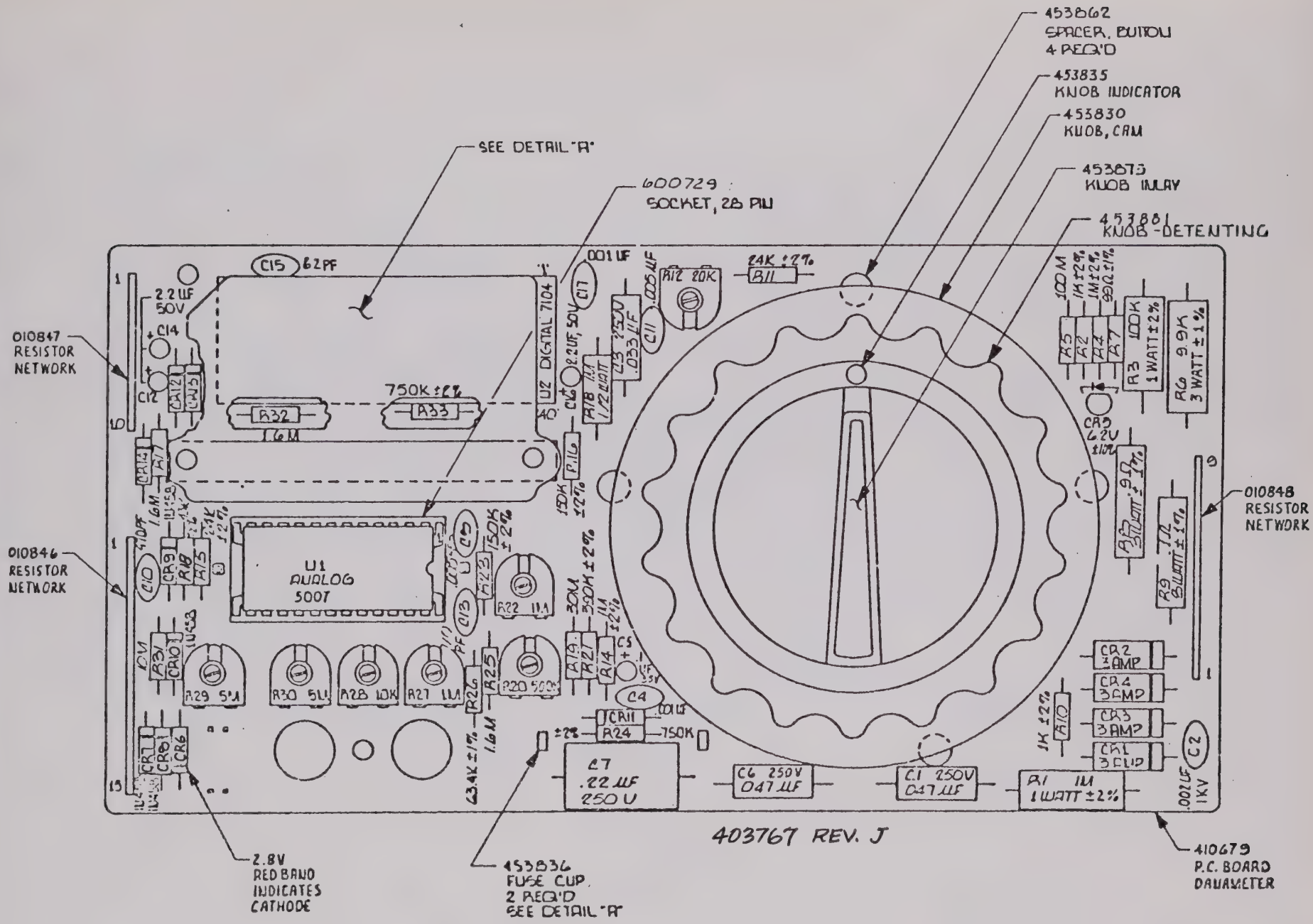


Figure 6.2 - 2000 Dmmeter (Rev. B & C) Assembly Drawing (Component Side)

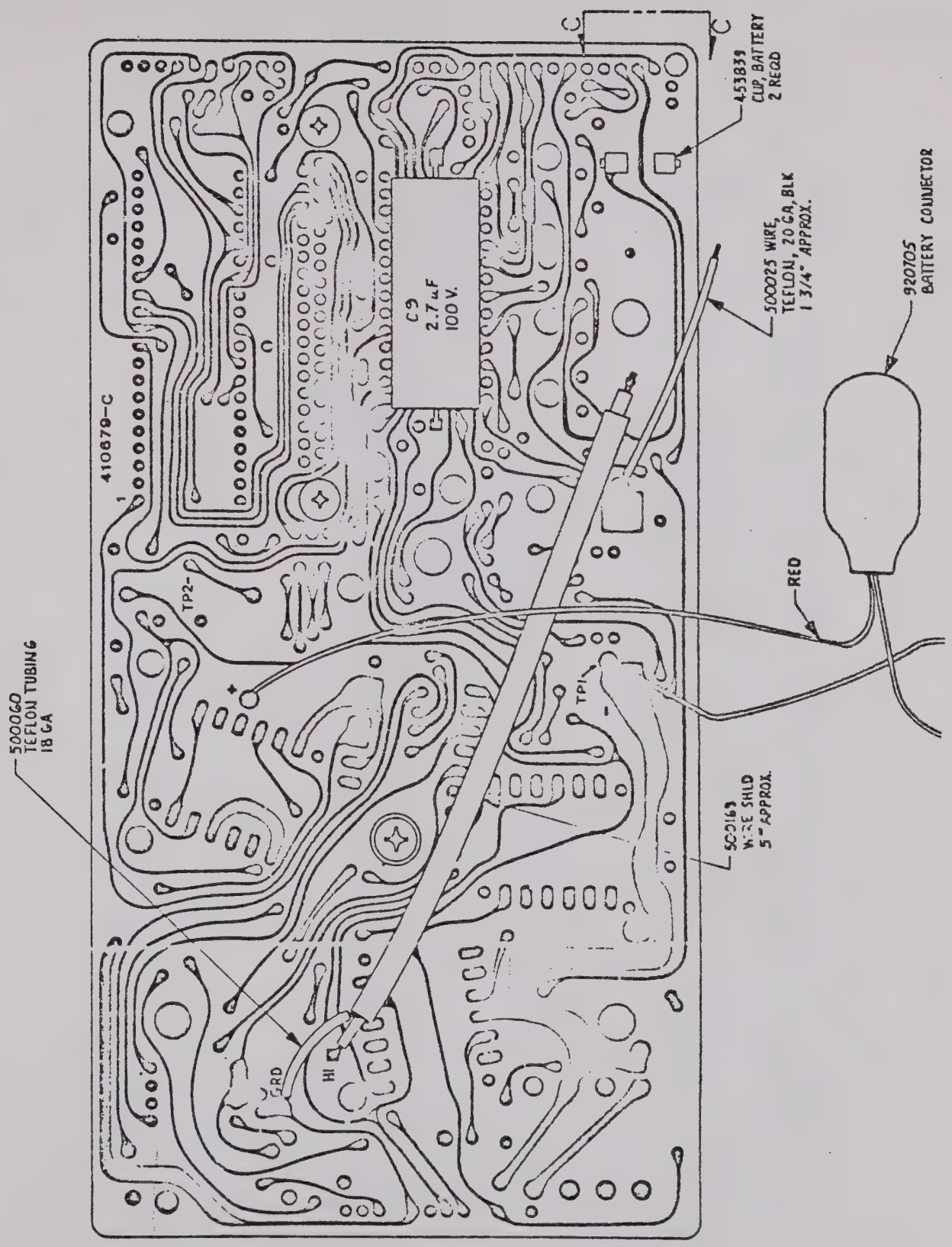


Figure 6.3 - 2000 Danameter (Rev. B & C) Assembly Drawing (Circuit Side)

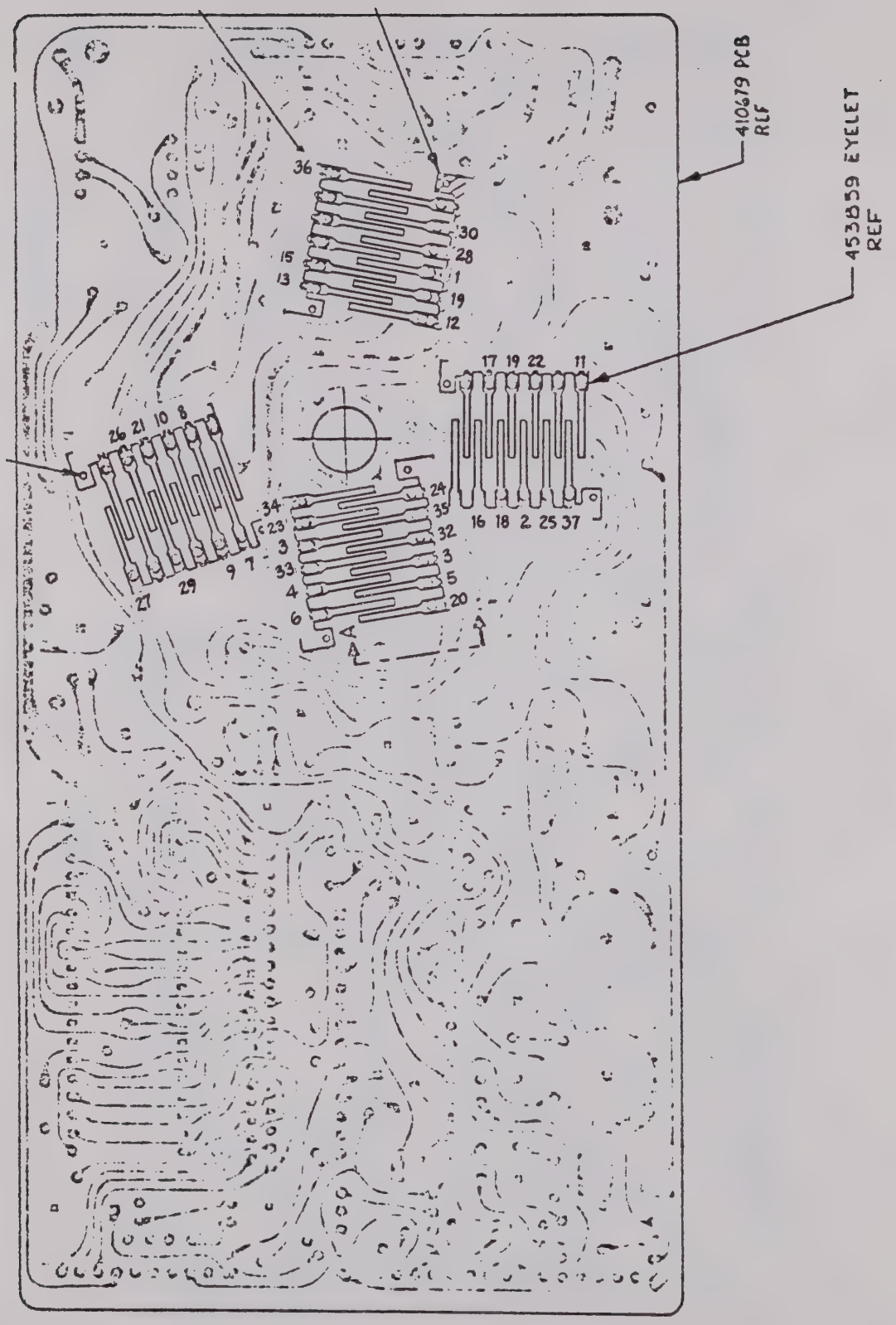


Figure 6.4 - 2000 Danameter (Rev. B & C) Switch Outline

Table 6.4 - 2000 (A) Calibration Check (Rev. E to L)

Danameter Switch	Standard		Danameter Readout	Acceptable Range
	Type	Output		
2 VDC	DC	0	.000	(Must Read Zero)
		+.1	+.100	+.099 to +.101
		−.1	−.100	−.099 to −.101
		+1	+1.000	+.994 to +1.006
		−1	−1.000	−.994 to −1.006
		+1.9	+1.900	+1.890 to +1.910
		−1.9	−1.900	−1.890 to −1.910
20 VDC		+10V	+10.00	+9.92 to +10.08
200 VDC		+100V	+100.0	+99.2 to +100.8
1 K VDC		+1000V	+1000	+992 to 1008
Reduce Standard Output and Remove from Meter Input				
2 VAC	AC	0	.000	.000 to .002
		.1V @ 1 KHz	.100	.097 to .103
		1V @ 1 KHz	1.000	.973 to 1.027
		1.9V @ 1 KHz	1.900	.950 to 1.050
20 VAC		19V @ 1 KHz	19.00	18.50 to 19.50
200 VAC		190V @ 1 KHz	190.0	185.0 to 195.0
1 K VAC		700V @ 1 KHz	700	681 to 719
Reduce Standard Output and Remove from Meter Input				
200Ω	Resistance	0	00.0	00.0 to 00.2
		100	100.0	96.3 to 103.7
20KΩ		10KΩ	10.00	9.84 to 10.16
2MΩ		1MΩ	1.000	.964 to 1.036
200MΩ		100MΩ	100.0	91.9 to 108.1
Remove Standard from Meter Input				
20μA	Current	+19μA	+19.00	+18.60 to +19.40
2mA		+1.9mA	+1.900	+1.860 to +1.940
200mA		+190mA	+190.0	+186.0 to +194.0
2A		+1.9A	+1.900	+1.860 to 1.940
Reduce Standard Output and Remove from Meter Input				

Table 6.5 - Danameter Model 2000 (Rev. E to L)

SWITCH NOMENCLATURE	OFF	TEST	DCV 2	DCV 20	DCV 200	DCV 1000	ACV 2	ACV 20	ACV 200	ACV 1000	OHMS 200	OHMS 20K	OHMS 2M	OHMS 200M	CURRENT (DC) 20μA	CURRENT (DC) 2mA	CURRENT (DC) 200mA	CURRENT (DC) 2A	FUNCTION (RANGE) SWITCHES
DC INPUT TO RANGE ATTENUATOR			■	■	■	■													1
AC INPUT							■	■	■	■									2
1μA CURRENT SOURCE											■								3
10μA CURRENT SOURCE												■							4
1μA CURRENT SOURCE													■						5
10nA CURRENT SOURCE														■					6
10KΩ CURRENT SHUNT															■				7
100Ω CURRENT SHUNT																■			8
1Ω CURRENT SHUNT																	■		9
.1Ω CURRENT SHUNT																		■	10
9MΩ /1MΩ VOLTAGE DIVIDER (≈1 Vdc)		■																	11
DIRECT DCV INPUT			■																12
÷ 10 DCV INPUT				■															13
÷ 100 DCV INPUT					■														14
÷ 1000 DCV INPUT						■													15
DIRECT ACV INPUT							■												16
÷ 10 ACV INPUT								■											17
÷ 100 ACV INPUT									■										18
÷ 1000 ACV INPUT										■									19
OHMS CURRENT TO ISOLATOR											■	■	■	■					20
DC CURRENT TO ISOLATOR															■	■	■	■	21
AC CONVERTER OUTPUT TO ISOLATOR							■	■	■	■									22
PROTECTION CLAMP CKT							■	■	■	■	■					■	■	■	23
ISOLATOR INPUT FILTER		■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	24
AC CONVERTER ENABLE							■	■	■	■									25
AC FILTER - AC CONV - OUT		■	■	■	■	■					■	■	■	■	■	■	■	■	26
ISOLATOR GAIN (2KΩ)											■	■			■	■	■	■	27
DCV POLARITY LOGIC			■	■	■	■													28
DC CURRENT POLARITY LOGIC															■	■	■	■	29
NOT USED																			30
2 RNG DECIMAL POSITION			■				■						■			■		■	31
20 RNG DECIMAL POSITION				■				■				■			■				32
200 RNG DECIMAL POSITION					■				■		■			■			■		33
9V BATTERY ENABLE		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	34
NOT USED		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	35
DC (I, V, R) SIG. INPUT		■	■	■	■	■					■	■	■	■	■	■	■	■	36
OHMS AMP OUTPUT TO I RESISTORS											■	■	■	■					37

■ SWITCH CLOSURE

Table 6.6 - Danameter 2000 (Rev. E to L) Reference Cell

	TEST	DCV	ACV	OHMS	DC CURRENT	FUNCTION
	–	2	20 @ 1 KHz	20KΩ	200mA	RANGE
U4 PIN	10.03	–1.916	19.06	19.00	–190.4	READING
1	+.00032	–.00040	–.0045	–.00042	–.017	LO IN (ISO LO + IN)
2	–.0185	–.001	–.0120	–.001	–.019	Gm 2 (ISO LO – IN)
3	+9.354	+9.318	+9.296	+9.327	+9.292	COMP 2 (ISO LO AMP)
4	–.00003	–0.00004	–.00003	–0.00003	–.017	GND POWER SUPPLY
5	+9.545	–.2446	+9.486	+9.511	–.261	POL LOGIC LEVEL
6	◇13◇	◇17◇				$\overline{IR}$ REF. INTEGRATE
7	◇14◇	◇18◇				$\overline{3K}$ SIG. INTEGRATE
8	◇15◇	◇19◇				C1 INTEGRATOR AMP IN
9	◇16◇	◇20◇				ND NULL DET OUT
10	+1.836	–.822	+2.655	+1.188	+.730	OHMS REF (AMP INPUT)
11	+1.992	–.893	+2.878	+1.187	+.792	OHMS OUT
12	+.100	+.096	+1.883 ◇21◇	+.095	+.078	AC OUT (+ OUT)
13	+.017	+.018	–.008 ◇22◇	+.017	–.000	Gm 3 (– OUT)
14	–8.664	–8.515	–8.282	–8.545	–8.560	–9V POWER SUPPLY
15	+9.330	+9.292	+9.231	+9.300	+9.284	COMP 3 (AC CONV)
16	–7.777	–6.882	–6.660	–6.900	–6.904	AR ISO BIAS
17	+.0156	+.0153	–.000 ◇23◇	–.085	–.000	AC IN (+ IN)
18	+.0160	+.0158	+9.315	+.0771	–.000	AC ENABLE
19	+9.850	+9.817	+9.786	+9.812	+9.796	+9V POWER SUPPLY
20	–8.000	–7.875	–7.658	–7.890	–7.903	BP (CHIP CURRENT REG FILTER)
21	+1.381	+1.380	+1.381	+1.381	+1.363	CO (INTEGRATOR CAP COMP)
22	+1.367	+1.367	+1.367	+1.367	+1.350	BR (REF CELL/ZENER INPUT)
23	+1.366	+1.366	+1.366	+1.366	+1.349	RR (REFERENCE COMPENSATION)
24	+1.368	+1.368	+1.368	+1.368 O/L	+1.351	RS (CHIP CURRENT REG LOAD)
25	+.993	–1.984	+1.878	+.187	–.207	BSV (BOOTSTRAP AMP OUTPUT)
26	+9.350	+9.324	+9.285	+9.250	+9.250	COMP 1 (ISO HI AMP)
27	+.9921	–1.898	+1.877	+.186	–.208	Gm 1 (ISO HI – IN)
28	+.9915	–1.719	+1.552	+.167	–.187	HI IN (ISO HI + IN)

U2–14
+1.694

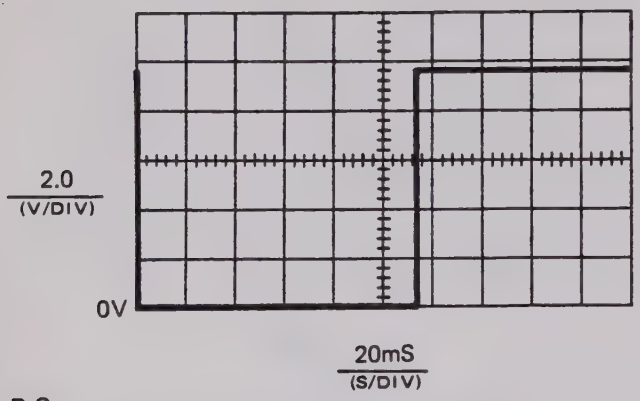
Table 6.7 - Danameter 2000 (Rev. E to L) Reference Zener

	TEST	DCV	ACV	OHMS	DC CURRENT	FUNCTION
	–	20	20 @ 1 KHz	2MΩ	200mA	RANGE
U4 PIN	1004	+18.92	19.26	1.909	+188.9	READING
1	–.0003	–.00036	–.0040	–.0003	+.019	LO IN (ISO LO + IN)
2	–.0056	–.003	–.0021	–.0016	+.018	Gm 2 (ISO LO – IN)
3	+9.327	+9.314	+9.287	+9.307	+9.330	COMP 2 (ISO LO AMP)
4	–.0000	–.0000	–.0000	–.0000	+.019	GND POWER SUPPLY
5	+9.451	+9.438	+9.412	+9.432	+9.446	POL LOGIC LEVEL
6	◇24◇		◇28◇			$\overline{IR}$ REF. INTEGRATE
7	◇25◇		◇29◇			$\overline{3K}$ SIG. INTEGRATE
8	◇26◇		◇30◇			C1 INTEGRATOR AMP IN
9	◇27◇		◇31◇			ND NULL DET OUT
10	+1.832	+2.640	+2.674	+2.272	+1.108	OHMS REF (AMP INPUT)
11	+2.010	+2.897	+2.936	+2.914	+1.215	OHMS OUT
12	+.400	+.370	+1.931◇32◇	+.368	+.392	AC OUT (+ OUT)
13	+.073	+.067	–.005 ◇33◇	+.067	+.087	Gm 3 (– OUT)
14	–8.657	–8.568	–8.353	–8.561	–8.537	-9V POWER SUPPLY
15	+9.300	+9.290	+9.220	+9.283	–9.298	COMP 3 (AC CONV)
16	–7.750	–6.890	–6.652	–6.871	–6.867	AR ISO BIAS
17	–.001	–.002	–.000 ◇34◇	–.002	–.001	AC IN (+ IN)
18	–.001	–.001	+9.312	–.000	–.000	AC ENABLE
19	+9.810	+9.797	+9.770	+9.791	+9.805	+9V POWER SUPPLY
20	–8.004	–7.924	–7.724	–7.919	–7.892	BP (CHIP CURRENT REG FILTER)
21	+1.210	+1.210	+1.210	+1.210	+1.229	CO (INTEGRATOR CAP COMP)
22	+1.200	+1.200	+1.200	+1.200	+1.219	BR (REF CELL/ZENER INPUT)
23	+1.200	+1.200	+1.200	+1.200	+1.219	RR (REFERENCE COMPENSATION)
24	+1.200	+1.200	+1.200	+1.200 O/L	+1.219	RS (CHIP CURRENT REG LOAD)
25	+1.004	+1.889	+1.920	+1.906	+.205	BSV (BOOTSTRAP AMP OUTPUT)
26	+9.324	+9.308	+9.278	+9.302	+9.257	COMP 1 (ISO HI AMP)
27	+1.006	+1.890	+1.920	+1.907	+.205	Gm 1 (ISO HI – IN)
28	+1.005	+1.891	+1.921	+1.909	+.206	HI IN (ISO HI + IN)

U2–14
+1.913

13 (NO.) $\overline{IR}$

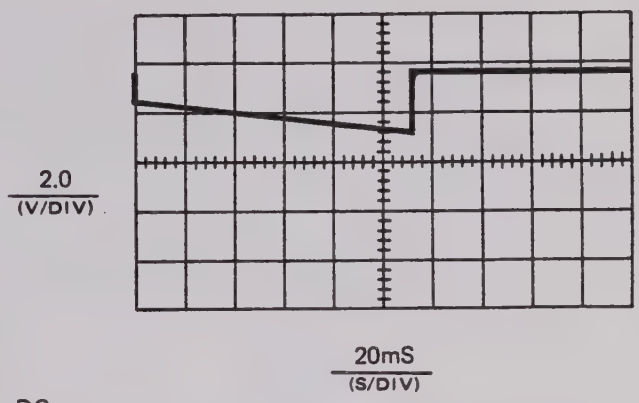
U4-6



D-C

14 (NO.) $\overline{3K}$

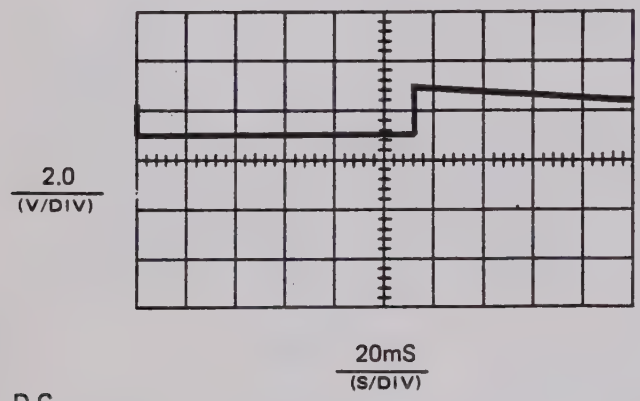
U4-7



DC

15 (NO.) INTEG AMP IN

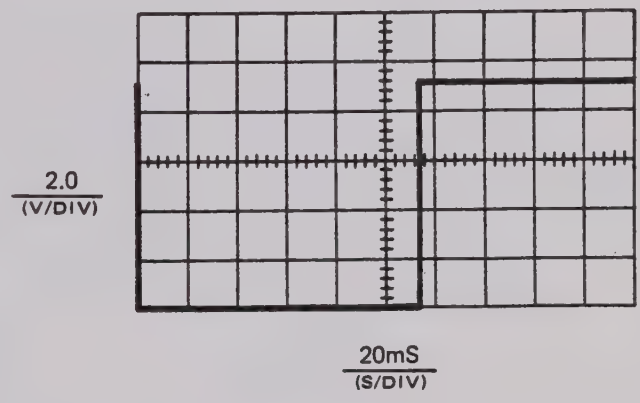
U4-8



D-C

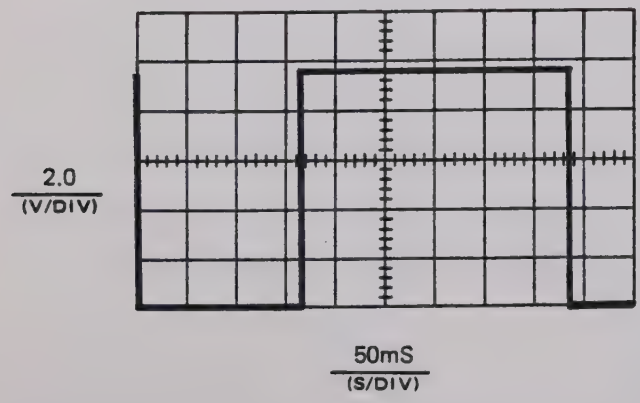
16 (NO.) ND

U4-9



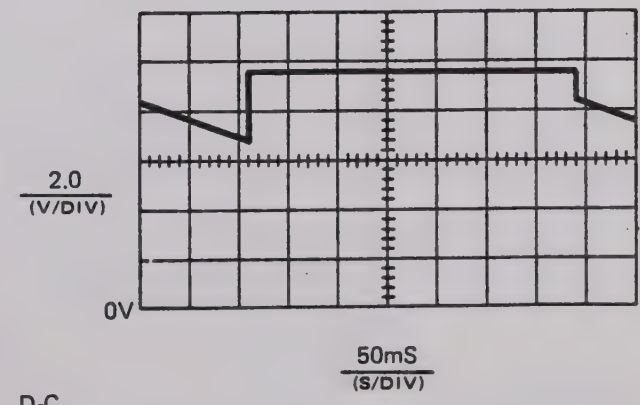
17 (NO.) $\overline{IR}$

U4-6



18 (NO.) $\overline{3K}$

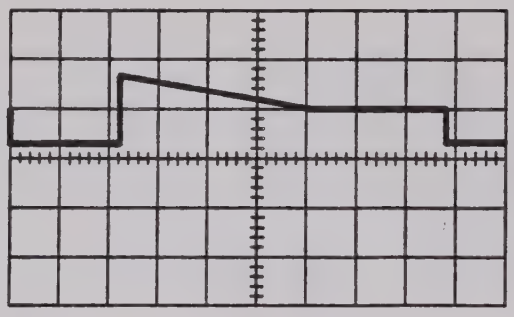
U4-7



D-C

19 (NO.) INTEG AMP IN

U4-8



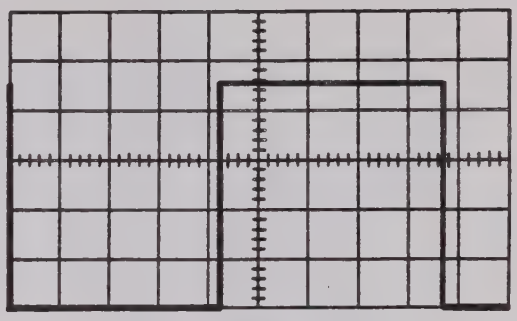
2.0 (V/DIV)

50mS (S/DIV)

D-C

20 (NO.) ND

U4-9



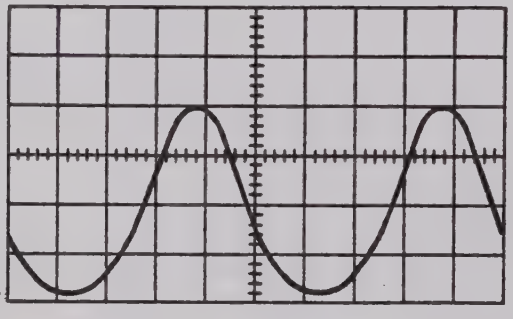
2.0 (V/DIV)

50mS (S/DIV)

DC

21 (NO.) AC OUT (+)

U4-12



1.0 (V/DIV)

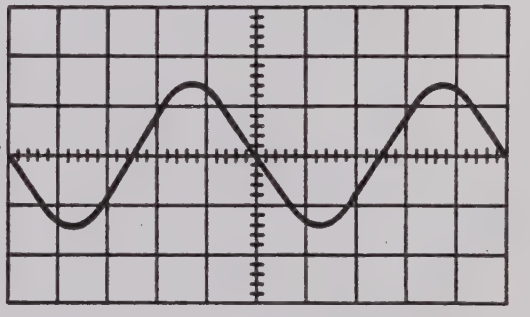
0V

.2mS (S/DIV)

D-C

22 (NO.) AC OUT (–)

U4-13



0V

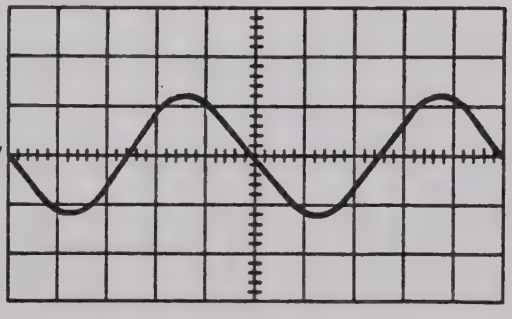
1.0 (V/DIV)

.2mS (S/DIV)

AC COUPLED

23 (NO.) AC IN

U4-17



0V

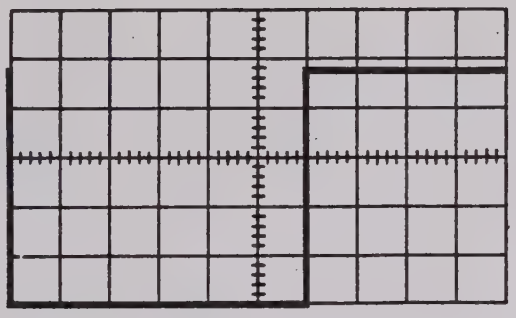
1.0 (V/DIV)

.2mS (S/DIV)

AC COUPLED

24 (NO.) $\overline{IR}$

U4-6

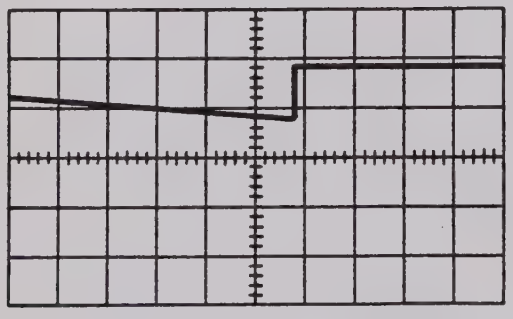


(V/DIV)

(S/DIV)

25 (NO.) 3K

U4-7



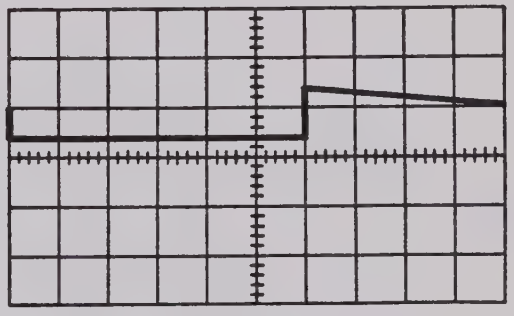
2.0 (V/DIV)

20mS (S/DIV)

DC

26 (NO.) INTEG AMP IN

U4-8



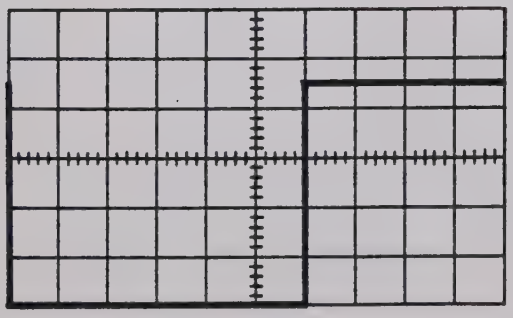
2.0 (V/DIV)

20mS (S/DIV)

D-C

27 (NO.) ND

U4-9



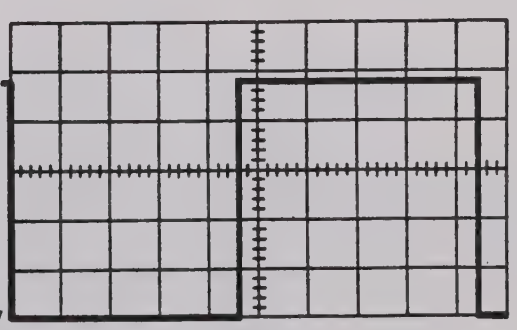
2.0 (V/DIV)

50mS (S/DIV)

D-C

28 (NO.) IR

U4-6



2.0 (V/DIV)

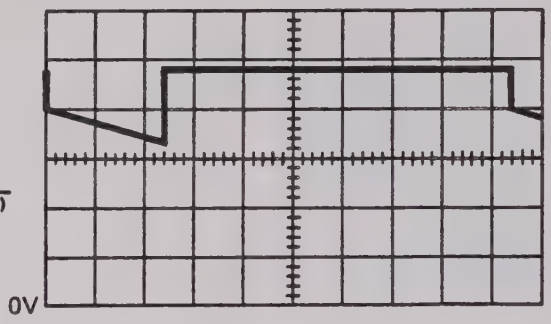
0V

50mS (S/DIV)

D-C

29 (NO.) 3K

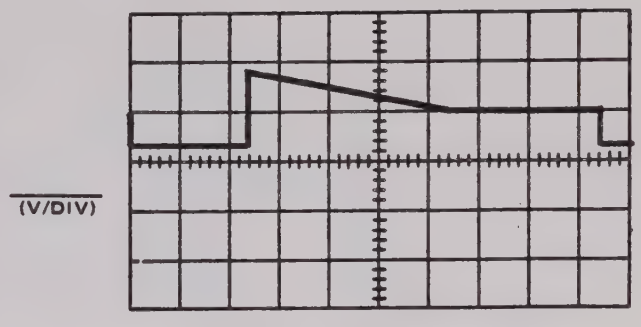
U4-7



D-C

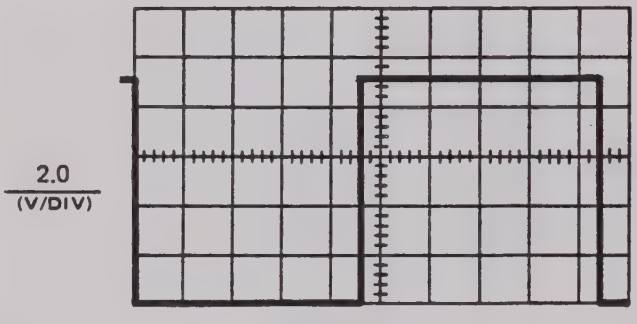
30 (NO.) INTEG AMP IN

U4-8



31 (NO.) ND

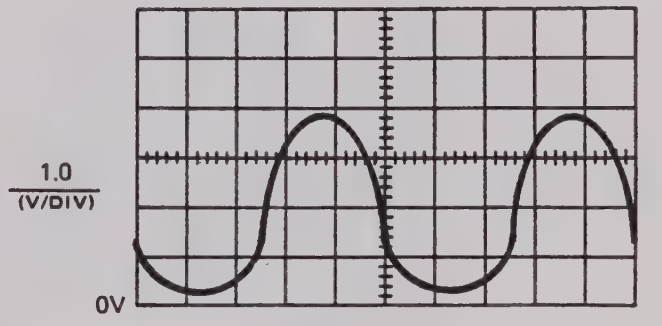
U4-9



D-C

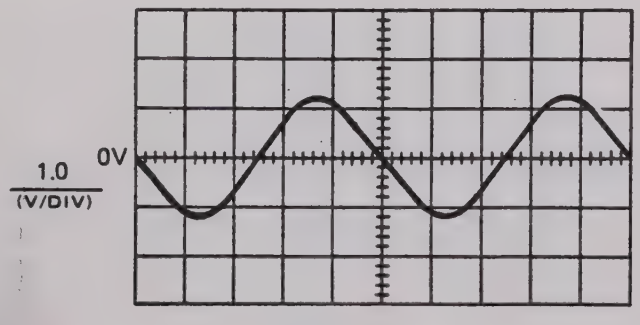
32 (NO.) AC OUT (+)

U4-12



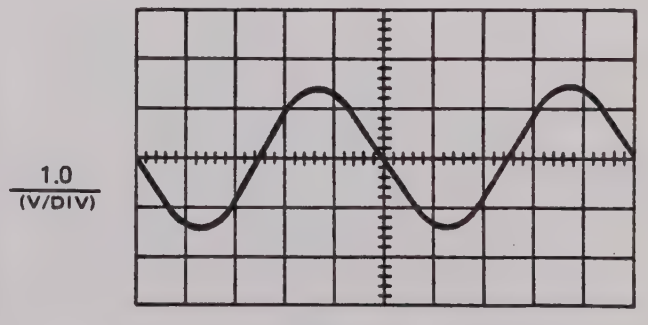
33 (NO.) AC OUT (–)

U4-13



34 (NO.) AC IN

U4-17



AC COUPLED

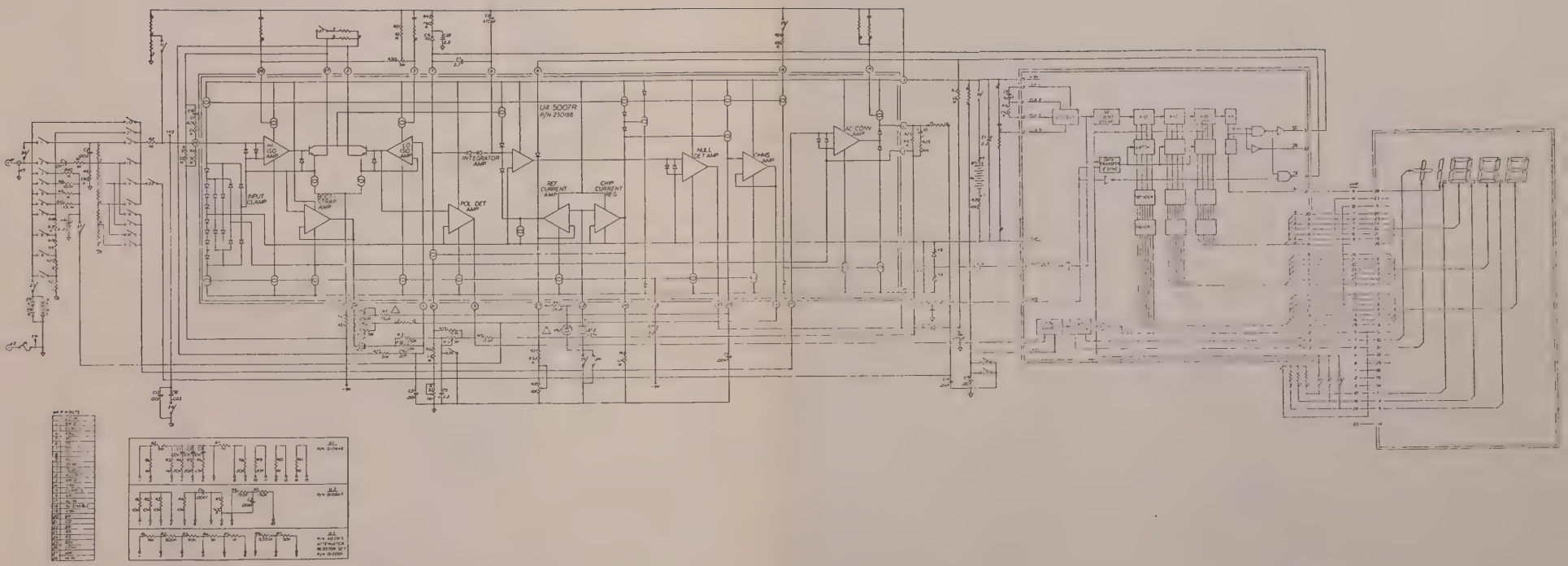


Figure 6.5 - Danameter Functional Schematic
2000 (A) Danameter Rev. E to T

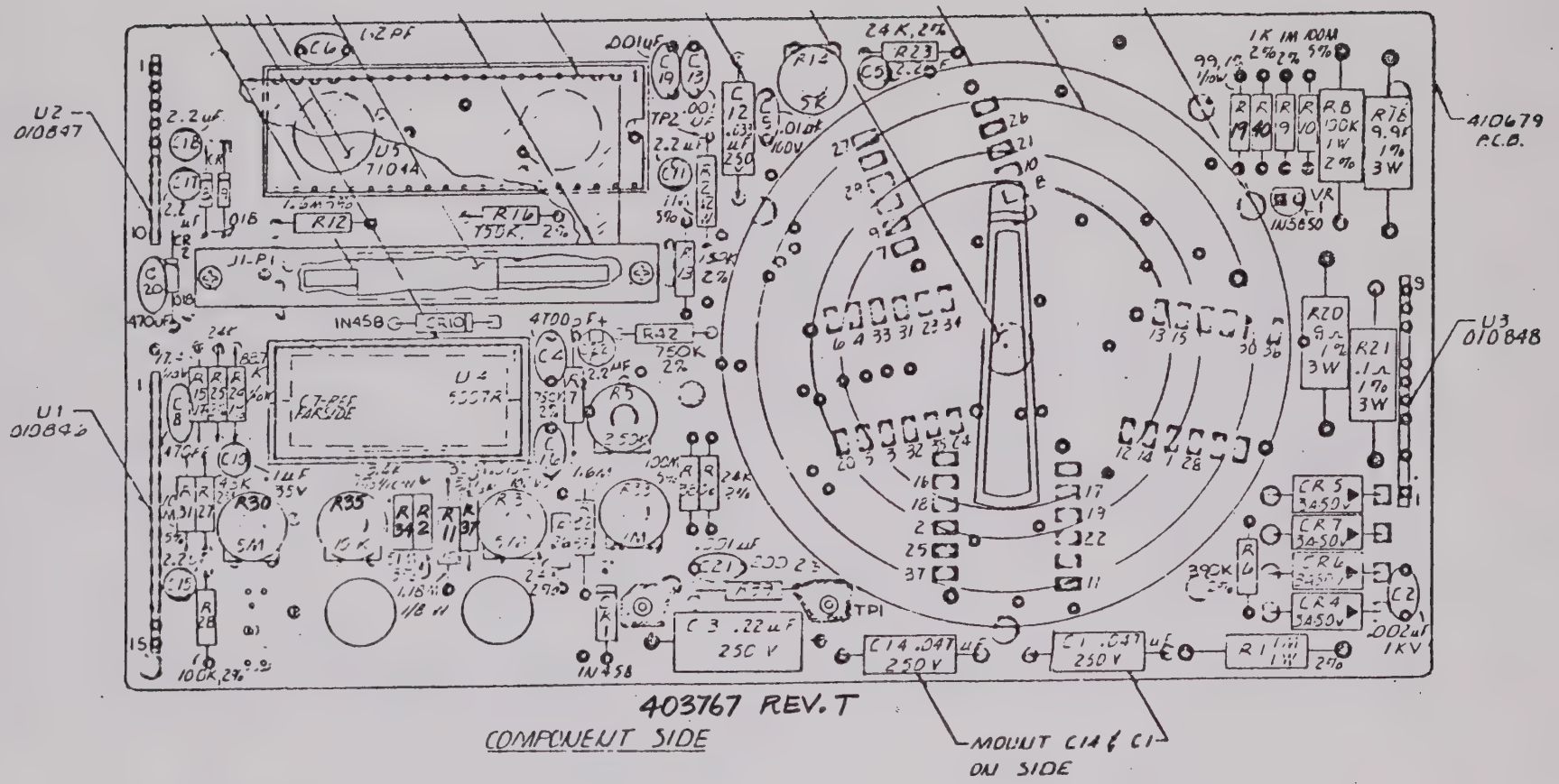


Figure 6.6 - 2000 (A) Danameter (Rev. E to L) Assembly Drawing (Component Side)

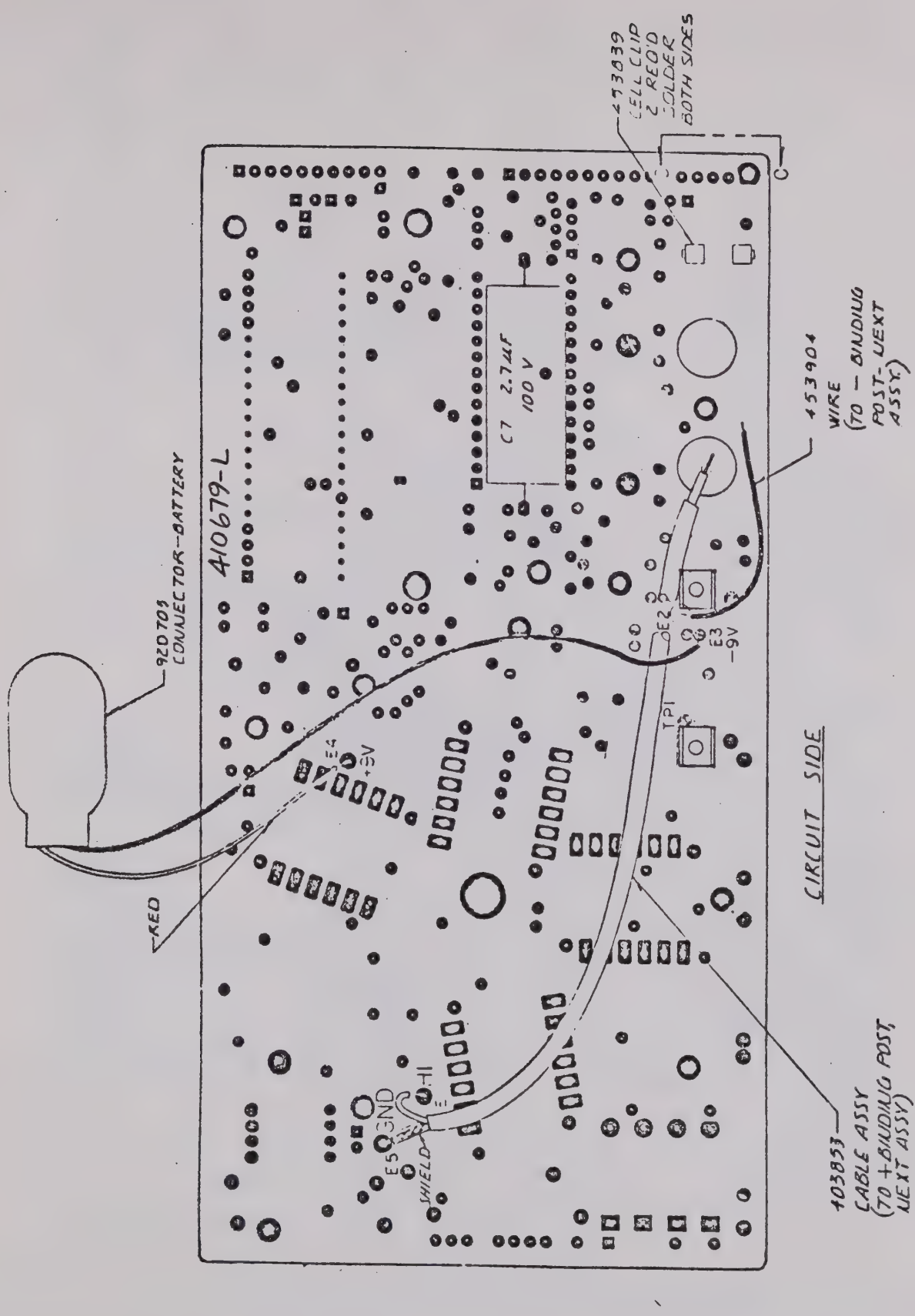


Figure 6.7 - 2000 (A) Danameter (Rev. E to L) Assembly Drawing (Circuit Side)

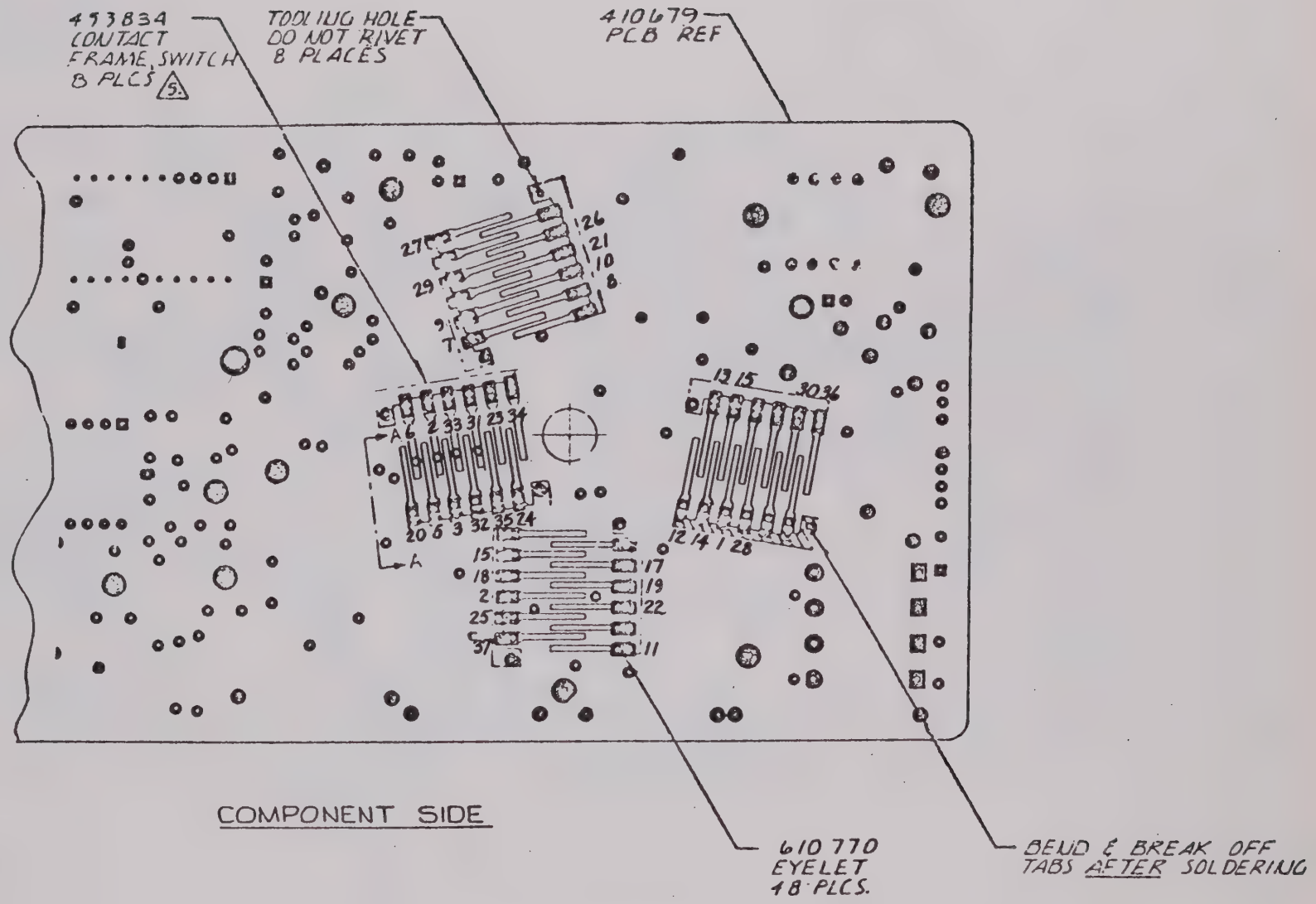


Figure 6.8 - 2000 (A) Danameter (Rev. E to L) Switch Outline

Table 6.8 - 2100 (A) Calibration Check (All Rev's)

Danameter Switch	Standard		Danameter Readout	Acceptable Range
	Type	Output		
2 VDC	DC	0	.000	(Must read zero)
		+.1	+.100	+.099 to +.101
		−.1	−.100	−.099 to −.101
		+1	+1.000	+.996 to +1.004
		−1	−1.000	−.996 to −1.004
		+1.9	+1.900	+1.894 to +1.906
		−1.9	−1.900	−1.894 to −1.906
20 VDC		+10V	+10.00	+9.95 to +10.05
200 VDC		+100V	+100.0	+99.5 to +100.5
1K VDC		+1000V	+1000	+995 to +1005
Reduce standard output and remove from meter input				
2 VAC	AC	0	.000	.000 to .002
		.1V @ 1 KHz	.100	.097 to .103
		1V @ 1 KHz	1.000	.988 to 1.012
		1.9V @ 1 KHz	1.900	1.879 to 1.921
20 VAC		19V @ 1 KHz	19.00	18.79 to 19.21
200 VAC		190V @ 1 KHz	190.0	187.9 to 192.1
1K VAC		700V @ 1 KHz	700	691 to 709
Reduce standard output and remove from meter input				
2KΩ	Resistance	0	.000	.000 to .002
		1KΩ	1.000	.993 to 1.007
20KΩ		10KΩ	10.00	9.94 to 10.06
200KΩ		100KΩ	100.0	99.4 to 100.6
20MΩ		10MΩ	10.00	9.91 to 10.09
Remove standard from meter input				
20μA	Current	+19μA	+19.00	+18.88 to +19.12
2mA		+1.9mA	+1.900	+1.888 to +1.912
200mA		+190mA	+190.0	+188.8 to +191.2
2A		+1.9A	+1.900	+1.888 to +1.912
Reduce standard output and remove from meter input				

Table 6.9 - Danameter Model 2100

SWITCH NOMENCLATURE	OFF	TEST	DCV 2	DCV 20	DCV 200	DCV 1000	ACV 2	ACV 20	ACV 200	ACV 1000	OHMS 2K	OHMS 20K	OHMS 200K	OHMS 20M	CURRENT (DC) 20μA	CURRENT (DC) 2mA	CURRENT (DC) 200mA	CURRENT (DC) 2A	FUNCTION (RANGE) SWITCHES
DC INPUT TO ATTENUATOR			■	■	■	■													1
AC INPUT							■	■	■	■									2
1μA CURRENT SOURCE											■								3
10μA CURRENT SOURCE												■							4
1μA CURRENT SOURCE													■						5
10nA CURRENT SOURCE														■					6
10KΩ CURRENT SHUNT															■				7
100Ω CURRENT SHUNT																■			8
1Ω CURRENT SHUNT																	■		9
.1Ω CURRENT SHUNT																		■	10
9MΩ/1MΩ VOLTAGE DIVIDER (≈1 Vdc)		■																	11
DIRECT DCV INPUT			■																12
÷ 10 DCV INPUT				■															13
÷ 100 DCV INPUT					■														14
÷ 1000 DCV INPUT						■													15
DIRECT ACV INPUT							■												16
÷ 10 ACV INPUT								■											17
÷ 100 ACV INPUT									■										18
÷ 1000 ACV INPUT										■									19
OHMS CURRENT TO ISOLATOR											■	■	■	■					20
DC CURRENT TO ISOLATOR															■	■	■	■	21
AC CONVERTER OUTPUT TO ISOLATOR							■	■	■	■									22
PROTECTION CLAMP CKT							■	■	■	■	■					■	■	■	23
ISOLATOR INPUT FILTER		■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■	24
AC CONVERTER ENABLE							■	■	■	■									25
AC FILTER - AC CONV - OUT		■	■	■	■	■					■	■	■	■	■	■	■	■	26
ISOLATOR GAIN (2KΩ)											■				■	■	■	■	27
DCV POLARITY LOGIC			■	■	■	■													28
DC CURRENT POLARITY LOGIC															■	■	■	■	29
NOT USED ENSATION + Vos																			30
2 RNG DECIMAL POSITION			■				■				■					■		■	31
20 RNG DECIMAL POSITION				■				■				■		■	■				32
200 RNG DECIMAL POSITION					■				■				■				■		33
9V BATTERY ENABLE		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	34
NOT USED																			35
DC (I, V, R) SIG. INPUT		■	■	■	■	■					■	■	■	■	■	■	■	■	36
OHMS AMP OUTPUT TO I RESISTORS											■	■	■	■					37

■ SWITCH CLOSURE

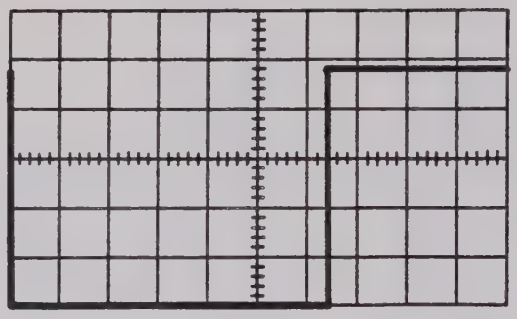
Table 6.10 - Danameter 2100 (Rev. A to H)

	TEST	DCV	ACV	OHMS	DC CURRENT	FUNCTION
	–	200	20 @ 1 KHz	200KΩ	200	RANGE
U4 PIN	985	–189.9	19.02	189.9	–190.0	READING
1	–.000	–.0002	–.0042	–.0002	–.017	LO IN (ISO LO + IN)
2	–.005	–.001	–.0124	–.009	–.017	Gm 2 (ISO LO – IN)
3	+9.305	+9.290	+9.263	+9.286	+9.244	COMP 2 (ISO LO AMP)
4	–.0000	–.0000	–.0000	–.0000	–.0000	GND POWER SUPPLY
5	+9.467	–.212	+9.426	+9.448	–.229	POL LOGIC LEVEL
6	◇35◇				◇42◇	$\overline{IR}$ REF. INTEGRATE
7	◇36◇				◇43◇	$\overline{3K}$ SIG. INTEGRATE
8	◇37◇				◇44◇	C1 INTEGRATOR AMP IN
9	◇38◇				◇45◇	ND NULL DET OUT
10	+2.497	+.085	+3.266	+2.821	+1.500	OHMS REF (AMP INPUT)
11	+2.985	+.100	+3.903	+3.896	+1.792	OHMS OUT
12	+.088	+.086	+1.910 ◇39◇	+.086	+.068	AC OUT (+ OUT)
13	+.015	+.015	–.006 ◇40◇	+.015	+.001	Gm 3 (– OUT)
14	–8.665	–8.571	–8.346	–8.563	–8.584	-9V POWER SUPPLY
15	+9.282	+9.270	+9.195	+9.264	+9.250	COMP 3 (AC CONV)
16	–7.772	–6.887	–6.664	–6.880	–6.900	AR ISO BIAS
17	–.001	–.001	–.001 ◇41◇	–.001	–.001	AC IN (+ IN)
18	–.000	–.000	+9.294	–.000	–.000	AC ENABLE
19	+9.797	+9.785	+9.755	+9.779	+9.776	+9V POWER SUPPLY
20	–8.008	–7.923	–7.710	–7.914	–7.934	BP (CHIP CURRENT REG FILTER)
21	+1.200	+1.200	+1.200	+1.200	+1.184	CO (INTEGRATOR CAP COMP)
22	+1.190	+1.190	+1.190	+1.190	+1.173	BR (REF CELL/ZENER INPUT)
23	+1.190	+1.190	+1.190	+1.190	+1.173	RR (REFERENCE COMPENSATION)
24	+1.191	+1.191	+1.191	+1.191 O/L	+1.174	RS (CHIP CURRENT REG. LOAD)
25	+.985	–1.899	+1.891	+1.897	–.205	BSV (BOOTSTRAP AMP OUTPUT)
26	+9.300	+9.294	+9.257	+9.283	+9.227	COMP 1 (ISO HI AMP)
27	+.984	–1.907	+1.890	+1.896	–.207	Gm 1 (ISO HI – IN)
28	+.985	–1.899	+1.893	+1.898	–.205	HI IN (ISO HI + IN)

U1–14
+1.702

35 (NO.) $\overline{IR}$

U4-6

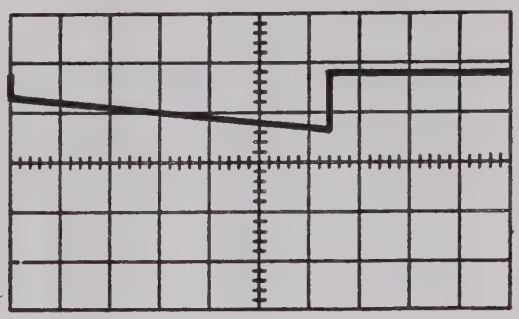


2.0 (V/DIV)

20mS (S/DIV)

36 (NO.) $\overline{3K}$

U4-7



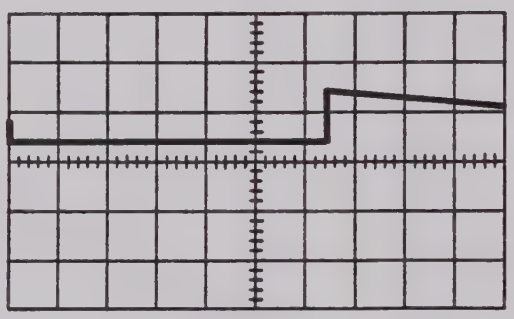
2.0 (V/DIV)

20mS (S/DIV)

D-C

37 (NO.) INTEG AMP IN

U4-8



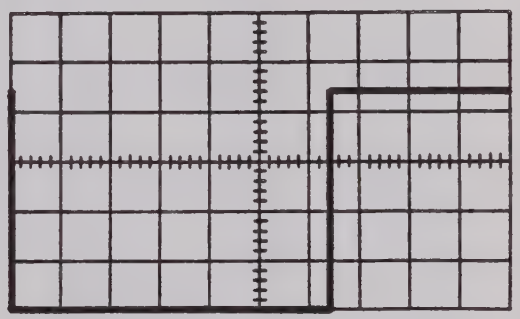
2.0 (V/DIV)

20mS (S/DIV)

D-C

38 (NO.) ND

U4-9



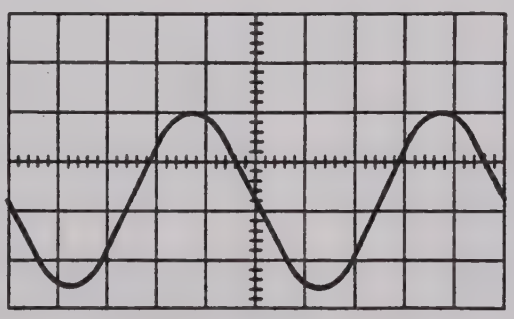
2.0 (V/DIV)

20mS (S/DIV)

D-C

39 (NO.) AC OUT (+)

U4-12



1.0 (V/DIV)

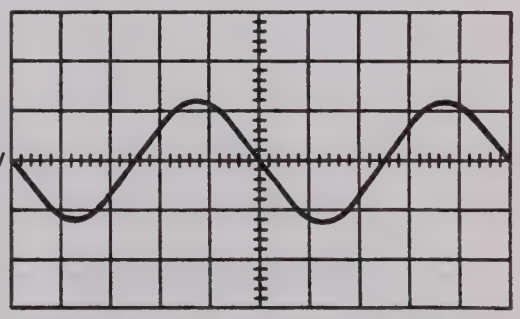
0V

.2mS (S/DIV)

D-C COUPLED

40 (NO.) AC OUT (–)

U4-13



1.0 (V/DIV)

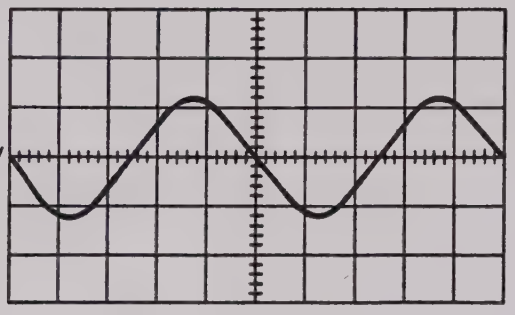
0V

.2mS (S/DIV)

A-C COUPLED

41 (NO.) AC IN

U4-17



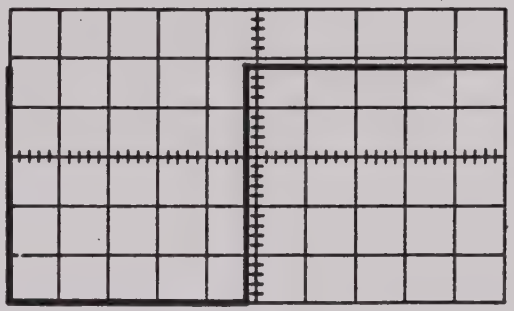
1.0 (V/DIV)

AC COUPLED

(S/DIV)

42 (NO.) $\overline{IR}$

U4-6



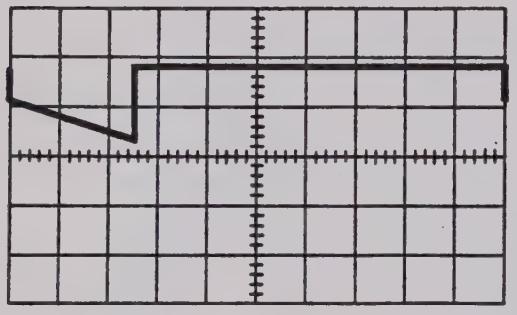
2.0 (V/DIV)

D-C

50mS (S/DIV)

43 (NO.) $\overline{3K}$

U4-7



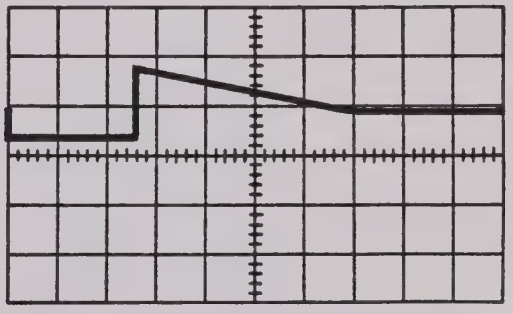
2.0 (V/DIV)

D-C

50mS (S/DIV)

44 (NO.) INTEG AMP IN

U4-8



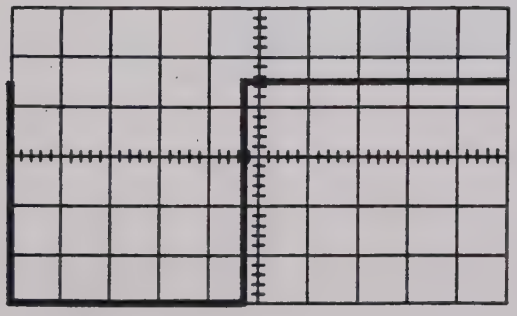
2.0 (V/DIV)

D-C

50mS (S/DIV)

45 (NO.) ND

U4-9



2.0 (V/DIV)

D-C

50mS (S/DIV)

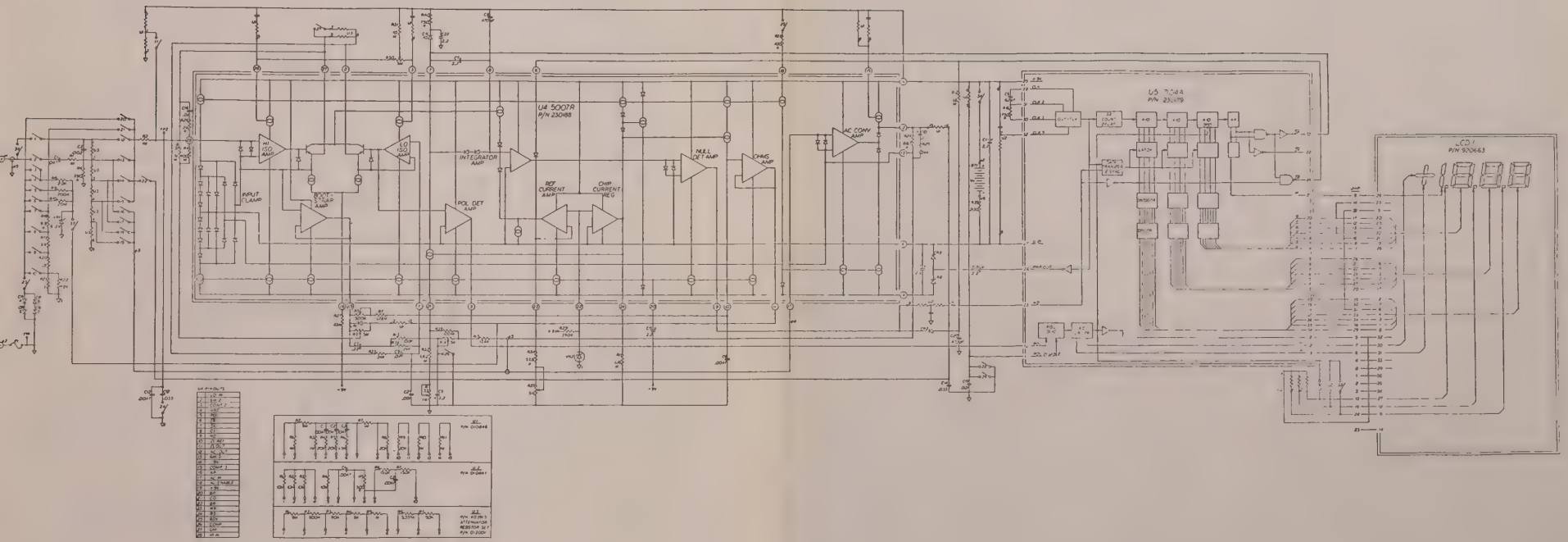


Figure 6.9 - Danameter Functional Schematic
2100 (A) Danameter Rev. A to H

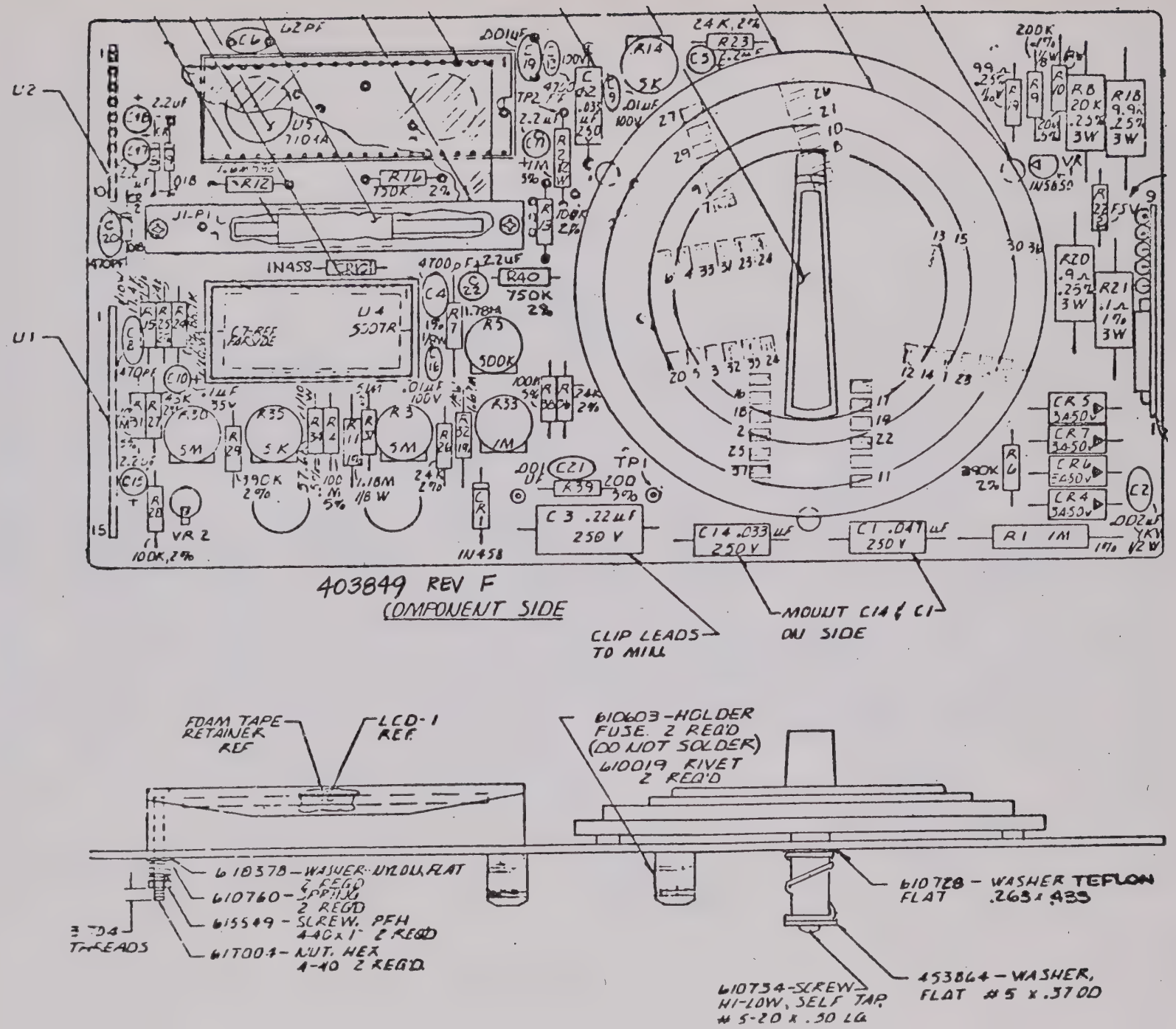

403849 REV F
COMPONENT SIDE
CLIP LEADS TO MILL
MOUNT C14 & C1 ON SIDE
FOAM TAPE RETAINER REF
LCD-1 REF.
610603-HOLDER FUSE. 2 REQ'D (DO NOT SOLDER)
610019 RIVET 2 REQ'D
610378-WASHER NYLON FLAT
610760-SPRING 2 REQ'D
615549-SCREW, PFH 4-40 x 1" 2 REQ'D
617004-NUT, HEX 4-40 2 REQ'D
3 TO 4 THREADS
610728-WASHER TEFLON FLAT .263 x .439
610734-SCREW HI-LOW, SELF TAP #5-20 x .50 LG
453864-WASHER, FLAT #5 x .370D

Figure 6.10 - 2100 (A) Dynamometer (All Rev's) Assembly Drawing (Component Side)

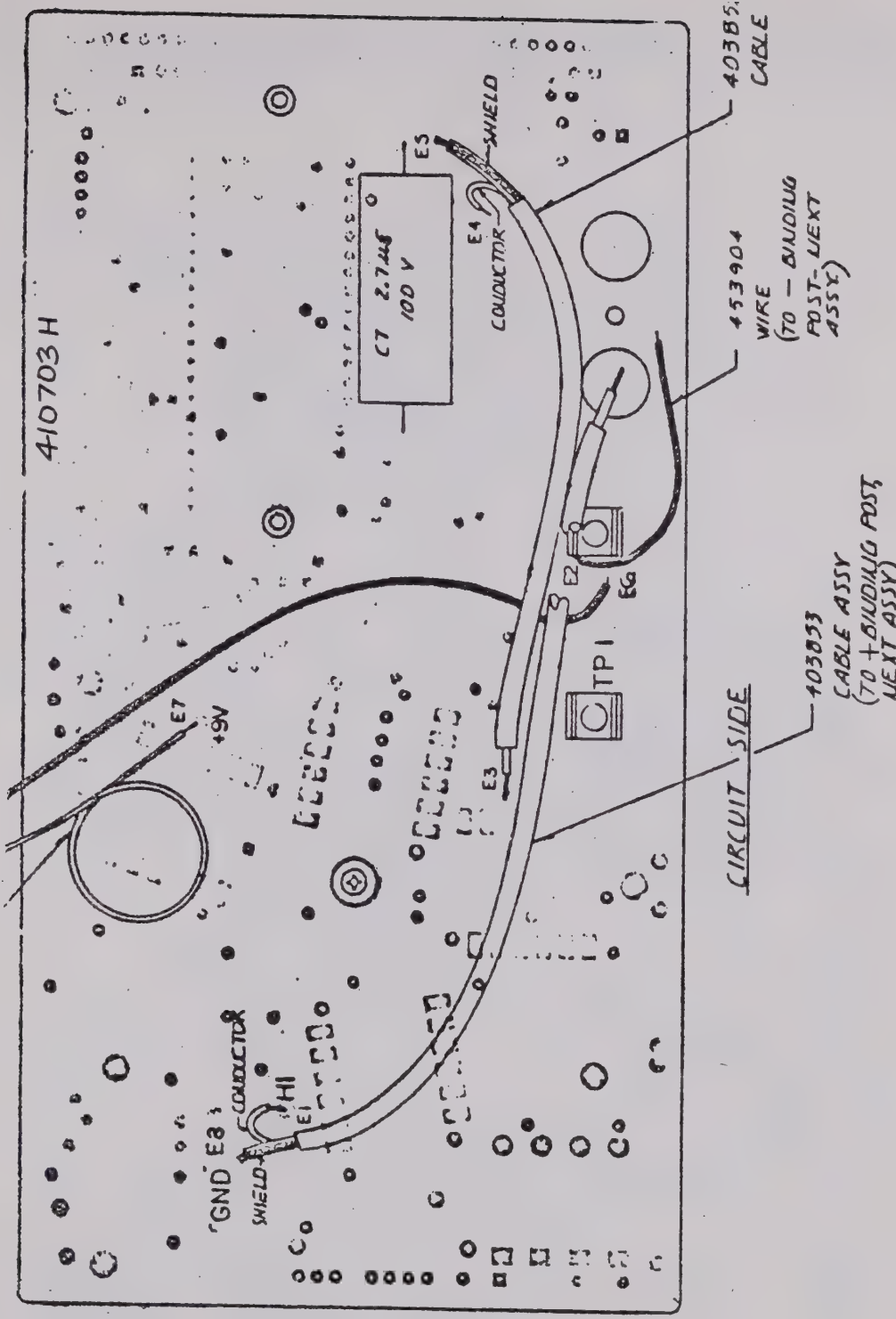


Figure 6.11 - 2100 (A) Danameter (All Rev's) Assembly Drawing (Circuit Side)

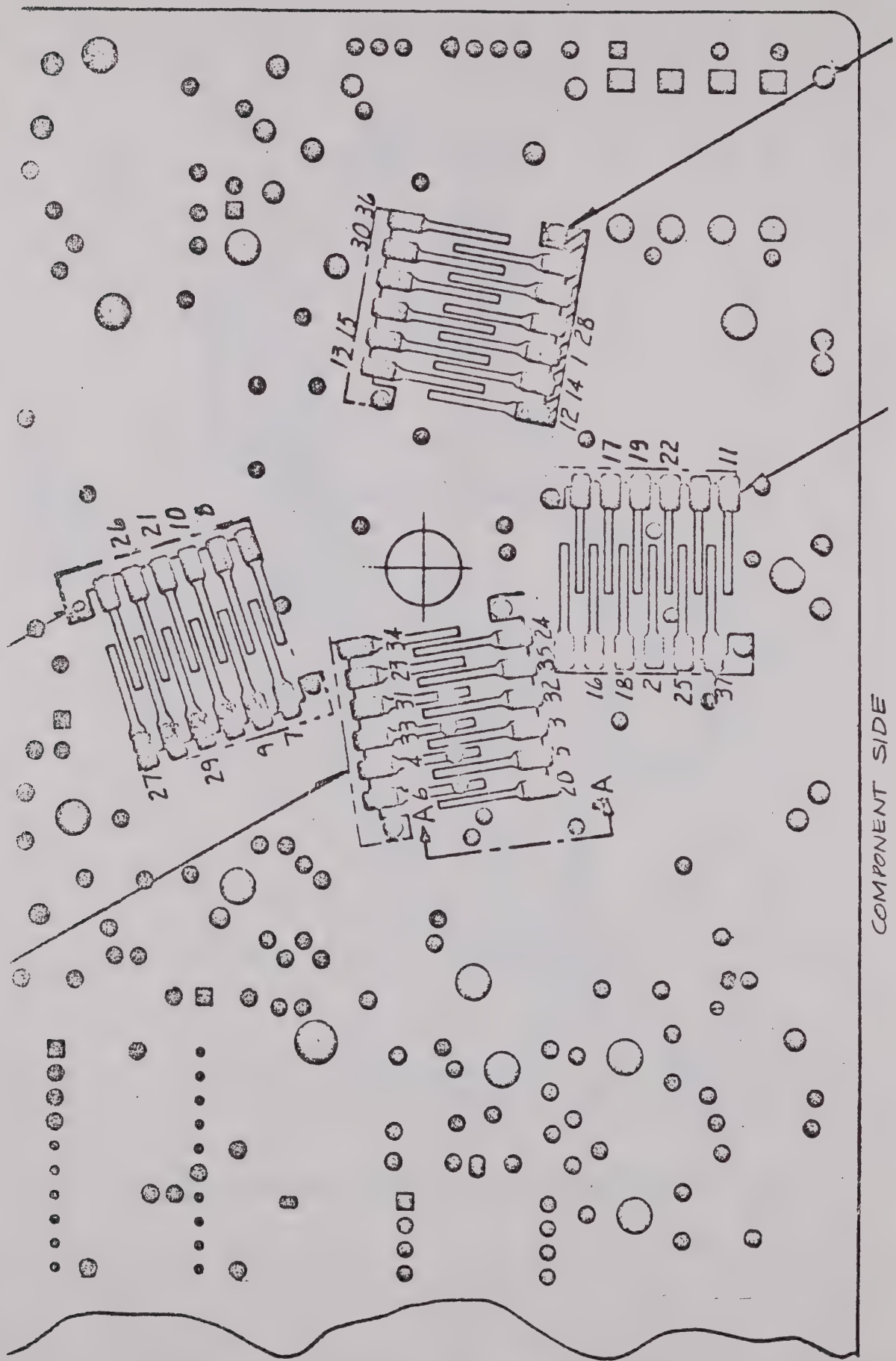


Figure 6.12 - 2100 (A) Danameter (All Rev's) Switch Outline

SECTION 7 CONFIGURATION HISTORY & PARTS LIST

2000 (Rev. to "E") Configuration History

R12 Originally 040284 Pot 25KΩ Carbon Changed to 040289 Jan '74

R20 Originally 040281 Pot 250KΩ Carbon Changed to 040290 Jan '74

R22 Originally 040282 Pot 1MΩ Carbon Changed to 040291 Jan '74

R27 Originally 040282 Pot 1MΩ Carbon Changed to 040291 Jan '74

R28 Originally 040283 Pot 10KΩ Carbon Changed to 040288 Jan '74

R29 Originally 040278 Pot 5MΩ Carbon Changed to 040292 Jan '74

R30 Originally 040278 Pot 5MΩ Carbon Changed to 040292 Jan '74

C13 Originally 100105 cap disc 62pf 100V changed to 100075 cap disc 10pf 1KV on Oct '74; changed to 120332 cap mylr .01μf 100V on Jan '75.

C4 Originally 100108 cap disc .001μf 500V changed to 120330 cap mylr .001μf 100V on Jan '75.

CR15 & CR16 Added on Jan '75 to "D" Rev.

VR1 (Option Ref Zener) added on Jan '75 to "D" Rev.

Res Ntwk - Atten changed to P/N 403915 on Oct '75.

2000 (Rev. to "L") Configuration History

R42, C22, & CR10 Added on Apr '75 to "H" Rev.

R10 Originally 001819, RES CC 100MΩ changed to 001886 on May '76.

U3 Res Ntwk atten changed to P/N 403915 on Oct '75.

2100 (Rev. to "H") Configuration History

R40, C22, & CR10 Added on Apr '75 to "B" Rev.

U3 Originally 010848 res ntwk attenuator changed to P/N 403915 on Oct '75 to "D" Rev.

Table 7.1 - 2000 Parts List (Rev. to E)

REF DESGN	P/N	COMP	TYPE	VALUE	TOL (%)	WATTAGE
R1	010855	RES	CF	1MΩ	2	1.0
R2	010834	RES	CF	1KΩ	2	.25
R3	010338	RES	CF	100KΩ	2	1.0
R4	010843	RES	CF	1MΩ	2	.25
R5	001819	RES	CC	100MΩ	5	.25
R6	020665	RES	WW	9.9KΩ	1	1.0
R7	010832	RES	MF	99Ω	1	-
R8	020666	RES	WW	.9Ω	1	3.0
R9	020664	RES	WW	.1Ω	1	3.0
R10	010852	RES	CF	390KΩ	2	.25
R11	010835	RES	CF	24KΩ	2	.25
R12*	040289	POT	CRMT	20KΩ	20	-
R13	010844	RES	CF	1MΩ	5	.5
R14	010843	RES	CF	1MΩ	2	.25
R15	010835	RES	CF	24KΩ	2	.25
R16	010839	RES	CF	150KΩ	2	.25
R17	001871	RES	CC	1.6MΩ	5	.25
R18	010851	RES	CF	43KΩ	2	.25
R19	001820	RES	CC	30MΩ	5	.25
R20*	040290	POT	CRMT	500K	20	-
R21	010852	RES	CF	390KΩ	2	.25
R22*	040291	POT	CRMT	1MΩ	20	-
R23	010839	RES	CF	150KΩ	2	.25
R24	010853	RES	CF	750KΩ	2	.25
R25	001871	RES	CC	1.6MΩ	5	.25
R26	010854	RES	MF	63.4KΩ	1	-
R27*	040291	POT	CRMT	1MΩ	20	-
R28*	040288	POT	CRMT	10KΩ	20	-
R29*	040292	POT	CRMT	5MΩ	30	-
R30*	040292	POT	CRMT	5MΩ	30	-
R31	001817	RES	CC	10MΩ	5	.25
R32	001871	RES	CC	1.6MΩ	5	.25
R33	010853	RES	CF	750KΩ	2	.25
R34	010835	RES	CF	24KΩ	2	.25
R35	010915	RES	CF	200Ω	2	.25
R36	010852	RES	CF	390K	2	.25

Table 7.1 - 2000 Parts List (Rev. to E) continued

REF DESGN	P/N	COMP	TYPE	VALUE	VOLTS	TOL
C1	120321	CAP	MYLR	.047μf	250	
C2	100109	CAP	DISC	.002μf	1K	+50 –20
C3	120320	CAP	MYLR	.033μf	250	
C4*	120330	CAP	MYLR	.001μf	100	
C5	110168	CAP	TANT	.1μf	35	
C6	120321	CAP	MYLR	.047μf	250	
C7	120322	CAP	MYLR	.22μf	250	
C8	100110	CAP	DISC	.0047μf	50	30
C9	120323	CAP	MYLR	2.7μf	100	
C10	100117	CAP	DISC	470pf	50	10
C11	100110	CAP	DISC	.0047μf	50	30
C12	110166	CAP	TANT	2.2μf	20	20
C13*	120332	CAP	MYLR	.01μf	100	
C14	110166	CAP	TANT	2.2μf	20	20
C15	100105	CAP	DISC	62pf	50	10
C16	110166	CAP	TANT	2.2μf	20	20
C17	100108	CAP	DISC	.001μf	50	10
C18	100117	CAP	DISC	470pf	50	10

REF DESGN	P/N	COMP	TYPE		
CR1	210054	DIODE	RECT	3A	50V
CR2	210054	DIODE	RECT	3A	50V
CR3	210054	DIODE	RECT	3A	50V
CR4	210054	DIODE	RECT	3A	50V
CR5	220071	DIODE	ZENER	10%	6.2V
CR6	210059	DIODE	STAB'STR		2.8V
CR7	210058	DIODE	1N458		
CR8	210058	DIODE	1N458		
CR9	210058	DIODE	1N458		
CR10	210058	DIODE	1N458		
CR11	210056	DIODE	018	MOD'FD	
CR12	210056	DIODE	018	MOD'FD	
CR13	210056	DIODE	018	MOD'FD	
CR14	210056	DIODE	018	MOD'FD	
CR15*	210058	DIODE	1N458		
CR16*	210058	DIODE	1N458		

Table 7.1 - 2000 Parts List (Rev. to E) continued

REF DESGN	P/N	COMP	TYPE		
VR1*	220076	DIODE	ZENER	REF	(OPTION ONLY)
U1	230178	IC	5007	ANALOG	LSI
U2	230179	IC	7104	DIGITAL	CMOS
-	010846	RES NTWK	ANALOG		
-	010847	RES NTWK	DIGITAL		
- *	010848	RES NTWK	ATTEN.		
-	920663	LCD			
BT1	920669	BATT	9V		
BT2	403814	BATT	1.35V	REF. CELL	
F1	920698	FUSE	250V	2.5A	

*See Parts List Configuration History

Table 7.2 --2000 Parts List (Rev. to L)

REF DESGN	P/N	COMP	TYPE	VALUE	TOL (%)	WATTAGE
R1	010855	RES	CF	1MΩ	2	1
R2	010844	RES	CF	1MΩ	5	.5
R3	040292	POT	CRMT	5MΩ	30	-
R4	001876	RES	CC	51MΩ	5	.25
R5	040295	POT	CRMT	250KΩ	20	-
R6	010852	RES	CF	390KΩ	2	.25
R7	010853	RES	CF	750KΩ	2	.25
R8	010838	RES	CF	100KΩ	2	.25
R9	010843	RES	CF	1MΩ	2	.25
R10*	001886	RES	CC	100MΩ	5	.25
R11	010887	RES	MF	1.18MΩ	1	.125
R12	001871	RES	CC	1.6MΩ	5	.25
R13	010839	RES	CF	150KΩ	2	.25
R14	040293	POT	CRMT	5KΩ	20	-
R15	010883	RES	MF	17.4KΩ	1	.1
R16	010853	RES	CF	750KΩ	2	.25
R17	-	-	-	-	-	-
R18	020665	RES	WW	9.9KΩ	1	3.
R19	010832	RES	MF	99Ω	1	.1
R20	020666	RES	WW	.9Ω	1	3.
R21	020664	RES	WW	.1Ω	1	3.
R22	-	-	-	-	-	-
R23	010835	RES	CF	24KΩ	2	.25
R24	010885	RES	MF	88.7KΩ	1	.1
R25	010835	RES	CF	24KΩ	2	.25
R26	010835	RES	CF	24KΩ	2	.25
R27	010851	RES	CF	43KΩ	2	.25
R28	010893	RES	CC	100KΩ	2	.25
R29	-	-	-	-	-	-
R30	040292	POT	CRMT	5MΩ	30	-
R31	001817	RES	CC	10MΩ	5	.25
R32	001871	RES	CC	1.6MΩ	5	.25
R33	040291	POT	CRMT	1MΩ	20	-
R34	010854	RES	MF	63.4KΩ	1	.1
R35	040288	POT	CRMT	10KΩ	20	-
R36	010835	RES	CF	24KΩ	2	.25
R37	001820	RES	CC	30MΩ	5	.25
R38	001819	RES	CC	100MΩ	5	.25
R39	010915	RES	CF	200Ω	2	.25
R40	010834	RES	CF	1KΩ	2	.25
R41	010852	RES	CF	390KΩ	2	.25
R42*	010853	RES	CF	750KΩ	2	.25

Table 7.2 - 2000 Parts List (Rev. to L) continued

REF DESGN	P/N	COMP	TYPE	VALUE	VOLTS
C1	120321	CAP	MYLR	.047µf	250
C2	100109	CAP	DISC	.002µf	1K
C3	120322	CAP	MYLR	.22µf	250
C4	100110	CAP	DISC	4700pf	50
C5	110166	CAP	TANT	2.2µf	20
C6	100105	CAP	DISC	62pf	50
C7	120323	CAP	MYLR	2.7µf	100
C8	100117	CAP	DISC	470pf	50
C9	120332	CAP	PLYFLM	.01µf	100
C10	110168	CAP	TANT	.1µf	35
C11	110166	CAP	TANT	2.2µf	20
C12	120320	CAP	MYLR	.033µf	250
C13	120330	CAP	PLYFLM	.001µf	100
C14	120321	CAP	MYLR	.047µf	250
C15	110166	CAP	TANT	2.2µf	20
C16	120332	CAP	PLYFLM	.01µf	100
C17	110166	CAP	TANT	2.2µf	20
C18	110116	CAP	TANT	2.2µf	20
C19	100108	CAP	DISC	.001µf	50
C20	100117	CAP	DISC	470pf	50
C21	100108	CAP	DISC	.001µf	50
C22*	110116	CAP	TANT	2.2µf	20

REF DESGN	P/N	COMP	TYPE		
CR1	210058	DIODE	RECT	1N458	
CR2	210056	DIODE	GD	018	
CR3	-	-	-	-	
CR4	210054	DIODE	RECT	3A	50V
CR5	210054	DIODE	RECT	3A	50V
CR6	210054	DIODE	RECT	3A	50V
CR7	210054	DIODE	RECT	3A	50V
CR8	210056	DIODE	GP	018	
CR9	210056	DIODE	GP	018	
CR10*	210058	DIODE	RECT	1N458	

Table 7.2 - 2000 Parts List (Rev. to L) continued

REF DESGN	P/N	COMP	TYPE		
VR1	220071	DIODE	ZENER	1N5850	
U1	010846	RES NTWK	ANALOG		
U2	010847	RES NTWK	DIGITAL		
U3 *	010848	RES NTWK	ATTEN.		
U4	230188	IC	5007R	ANALOG	LSI
U5	230179	IC	7104A	DIGITAL	CMOS
LCD1	920663	LCD			

*See Parts Configuration History

Table 7.3 - 2100 Parts List (Rev. to H)

REF DESGN	P/N	COMP	TYPE	VALUE	TOL (%)	WATTAGE
R1	010890	RES	MF	1MΩ	5	.5
R2	010844	RES	CF	1MΩ	5	.5
R3	040292	POT	CRMT	5MΩ	30	-
R4	001819	RES	CC	100MΩ	5	.25
R5	040290	POT	CRMT	500KΩ	20	-
R6	010852	RES	CF	390KΩ	2	.25
R7	010889	RES	MF	1.78MΩ	1	.125
R8	020673	RES	WW	20KΩ	.25	3.
R9	010886	RES	MF	200KΩ	.1	.125
R10	010891	RES	MF	20MΩ	.5	.125
R11	010887	RES	MF	1.18MΩ	1	.125
R12	001871	RES	CC	1.6MΩ	5	.25
R13	010893	RES	CF	100KΩ	2	.25
R14	040293	POT	CRMT	5KΩ	20	-
R15	010883	RES	MF	17.4KΩ	1	.1
R16	010853	RES	CF	750K	2	.25
R17	-	-	-	-	-	-
R18	020672	RES	WW	9.9KΩ	.25	3.
R19	010882	RES	MF	99Ω	.25	.1
R20	020671	RES	WW	.9Ω	.25	3.
R21	020664	RES	WW	.1Ω	1.	3.
R22	FACTORY SELECTED VALUE					
R23	010835	RES	CF	24KΩ	2	.25
R24	010885	RES	MF	88.7KΩ	1	.1
R25	010835	RES	CF	24KΩ	2	.25
R26	010835	RES	CF	24KΩ	2	.25
R27	010851	RES	CF	43KΩ	2	.25
R28	010893	RES	CF	100KΩ	2	.25
R29	010852	RES	CF	390KΩ	2	.25
R30	040292	POT	CRMT	5MΩ	30	-
R31	001817	RES	CC	10MΩ	5	.25
R32	010888	RES	MF	1.62MΩ	1	.125
R33	040291	POT	CRMT	1MΩ	20	-
R34	010939	RES	MF	57.6KΩ	.5	.1
R35	040293	POT	CRMT	5KΩ	20	-
R36	010835	RES	CF	24KΩ	2	.25
R37	001876	RES	CC	51MΩ	5	.25
R38	001819	RES	CC	100MΩ	5	.25
R39	010915	RES	CF	200Ω	2	.25
R40*	010853	RES	CF	750KΩ	2	.25

Table 7.3 - 2100 Parts List (Rev. to H) continued

REF DESGN	P/N	COMP	TYPE	VALUE	VOLTS
C1	120321	CAP	MYLR	.047μf	250V
C2	100109	CAP	DISC	.002μf	1KV
C3	120322	CAP	MYLR	.22μf	250V
C4	100110	CAP	DISC	4700pf	50V
C5	110166	CAP	TANT	2.2μf	20V
C6	100105	CAP	DISC	62pf	50V
C7	120323	CAP	MYLR	2.7μf	100V
C8	100117	CAP	DISC	470pf	50V
C9	120332	CAP	PLYFLM	.01μf	100V
C10	110168	CAP	TANT	.1μf	35V
C11	110166	CAP	TANT	2.2μf	20V
C12	120320	CAP	MYLR	.033μf	250V
C13	120331	CAP	PLYFLM	4700pf	100V
C14	120320	CAP	MYLR	.033μf	250V
C15	110166	CAP	TANT	2.2μf	20V
C16	120332	CAP	PLYFLM	.01μf	100V
C17	110166	CAP	TANT	2.2μf	20V
C18	110166	CAP	TANT	2.2μf	20V
C19	100108	CAP	DISC	.001μf	50V
C20	100117	CAP	DISC	470pf	50V
C21	100108	CAP	DISC	.001μf	50V
C22*	110166	CAP	TANT	2.2μf	20V

REF DESGN	P/N	COMP	TYPE		
CR1	210058	DIODE	1N458		
CR2	210056	DIODE	018		
CR3					
CR4	210054	DIODE	RECT	3A	50V
CR5	210054	DIODE	RECT	3A	50V
CR6	210054	DIODE	RECT	3A	50V
CR7	210054	DIODE	RECT	3A	50V
CR8	210056	DIODE	018		
CR9	210056	DIODE	018		
CR10*	210058	DIODE	1N458		

Table 7.3 - 2100 Parts List (Rev. to H) continued

REF DESGN	P/N	COMP	TYPE	
VR1	220071	DIODE	ZENER	1N5850
VR2	220076	DIODE	ZENER	REFERENCE
U1	010846	RES NTWK	ANALOG	
U2	010847	RES NTWK	DIGITAL	
U3*	403915	RES NTWK	ATTEN.	
U4	IC	5007R	ANALOG	LSI
U5	IC	7104A	DIGITAL	CMOS
LCD1	920663	LCD		
BT1	920669	BATT	9V	
F1	920698	FUSE	250V	2.5A

*See Parts Configuration History

SECTION 8 APPENDIX

Section	Title	Page
8.1	Field Service Bulletin #20-1112 (measurement stability)	8-3
8.2	Field Service Bulletin #20-1113 (improve LCD readout)	8-7
8.3	Replacement Procedures for Bent or Broken Switch Spring Contacts	8-9
8.4	Rework Instructions to Add Opt. 03 to Rev. B & C 2000 Danameter	8-11
8.5	Field Service Bulletin #20-11141 (decimal point annunciation)	8-15

8.1 FIELD SERVICE BULLETIN NO. 20-1112.

SUBJECT:
Model 2000 Series Danameters

PURPOSE:
To enhance the reliability and performance of P/N 403767, Main PCB Assy. for the Danameter.

Specific Indications of Service are:

1. Intermittent or inconsistent instrument readings in any range.

2. Readings greater than 0.2 in 200 range with the input terminals shorted.

3. Loss of calibration and/or failure to read with signal applied.

This will be accomplished by:

1. Providing a procedure to lubricate the contact/contact surfaces for the function switch with "Cramolin" paste, a lubricant and anti-corrosive, contact cleaner.

2. Inspection of the calibration potentiometers to determine if replacement is necessary.

ACTION:
Danameters returned to service depots for warranty/non-warranty service must be disassembled by the following procedure:

1. Set the control switch to the OFF position.

2. Loosen the captive screw on the battery cover.

3. Swing the bail up and slide back the battery cover and remove.

4. Remove battery, fuse and center mounted rear panel screw.

5. Remove rear panel and guide battery cable/connector through the hole.

6. Remove the reference cell, unless the unit is equipped with the 03 option (reference zener), and set in a clean area until reassembly.

7. Unsolder the white shielded (+) and black (–) wires from the input terminals.

8. Remove the four PCB mounting screws and remove the PCB from the case (do not remove the switch retaining screw). (See Figure 1.)

9. Remove the switch assembly retaining screw, spacer (compression spring), and washers. (Note the order for re-assembly.)

10. Carefully apply a thin, but visible coat of Cramolin (TM), red paste, contact lubricant with a fine artists brush or equivalent instrument (NOT COTTON SWABS) to the switch contacts/pads (refer to areas outlined in Figure 2). Cramolin can be obtained from Dana Labs by ordering P/N 920774. Note: Care must be exercised to prevent bending or otherwise deforming the switch contacts during the application of the paste lubricant. (Incidental application to surfaces surrounding the switch pad is not detrimental to the instruments performance.)

11. Apply a thin film of lubricant to the surfaces of the switch cam lobes.

12. Re-install the switch assembly in the OFF position, observing the proper orientation of the bushing (if applicable), switch body, washers, spacer (compression spring), and screw. Tighten the switch retaining screw until it is snug to avoid stripping out the hole. (See Figure 3.)

13. Inspect the seven calibration potentiometers on the main PCB for solder fillets on the rivets for the mounting pins. If the fillets are missing or incomplete, the potentiometers must be replaced. (See Figure 4 for proper identification of the rivet fillets.)

    R-12 - P/N 040289 Pot Carbon 20K Ohm
    R-20 - P/N 040290 Pot Carbon 500K Ohm
    R-22 - P/N 040291 Pot Carbon 1M Ohm
    R-27 - P/N 040291 Pot Carbon 1M Ohm
    R-28 - P/N 040288 Pot Carbon 10K Ohm
    R-29 - P/N 040292 Pot Carbon 5M Ohm
    R-30 - P/N 040292 Pot Carbon 5M Ohm

14. Re-assemble the main PCB in the meter case, placing the control switch in the 1KVDC/10μA position to align the switch detents with the leaf spring mounted

to the meter case above the control switch (see Figure 5). Note: The PCB is mounted properly when the switch protrudes fully through the meter case and the switch detents normally.

15. Replace the four PCB mounting screws and check for proper detent action setting the control switch in the OFF position.

16. Re-solder the input terminals.

17. Re-install the reference cell after coating the contact surfaces of the cell and the retaining clips with a thin, visible coating of Cramolin. The large end (+) of the cell must be aligned with plus side of the retaining clip (Note "+" symbol on the PCB).

    Note: The following conditions can cause "loading" to the reference cell:

    a. The 9V battery disconnected AND
    b. The control switch NOT in the OFF position

    If the cell is temporarily loaded, it will indicate an increased value of the test reading. The test reading gradually decreases as the cell stabilizes. The time to stabilize depends on how severely the cell was loaded.

18. Re-calibrate as required. (Temporarily connect the fuse and battery if re-calibration is required.)

19. Replace the meter rear case, feeding the battery cable/connector through the hole, and replace the mounting screw.

20. Replace the fuse and CAREFULLY connect the 9V battery, observing the connector polarity alignment. (Control switch must be in the OFF position.)

21. Replace the battery cover, captive screw and test for proper operation.

EFFECTIVITY:
All Danameter main PCB assy., P/N 403767, through Revision C, shipped before 1 June 1975.

AUTHORITY:
Engineering Department

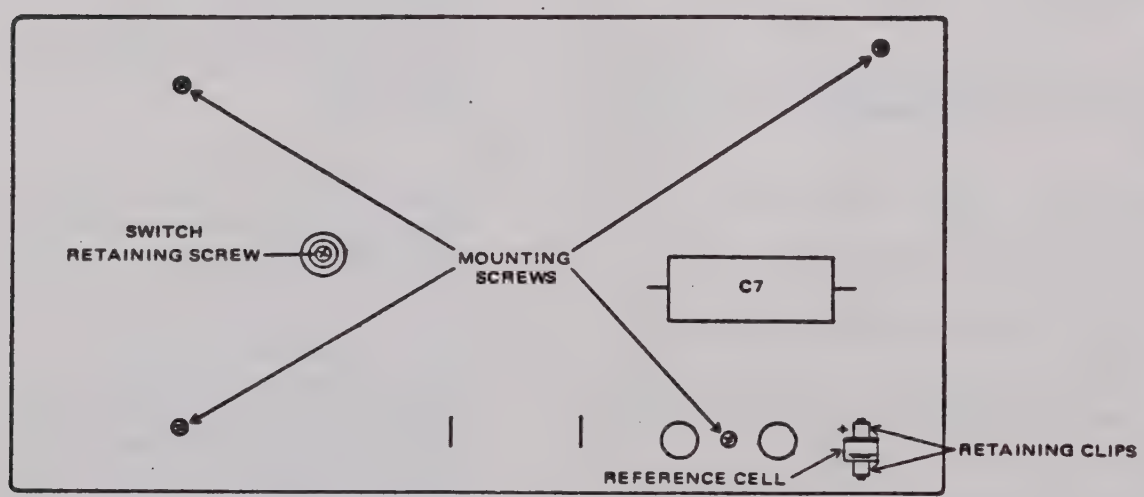


FIGURE 1
REAR PCB

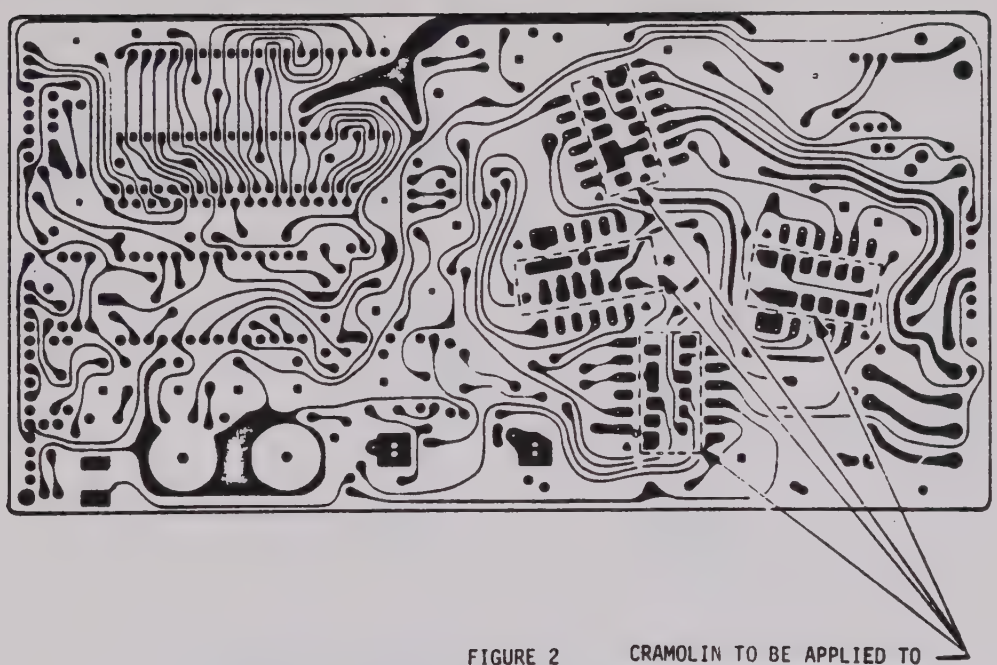


FIGURE 2
TOP PCB

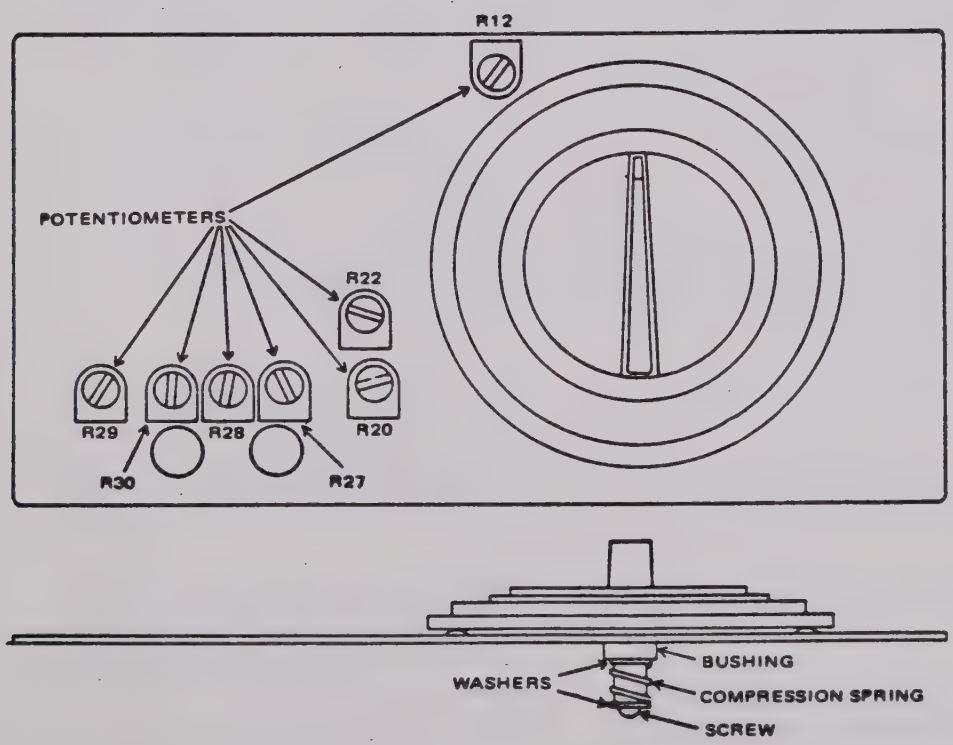


FIGURE 3
TOP/SIDE VIEW OF PCB
(SWITCH 8 POTS)

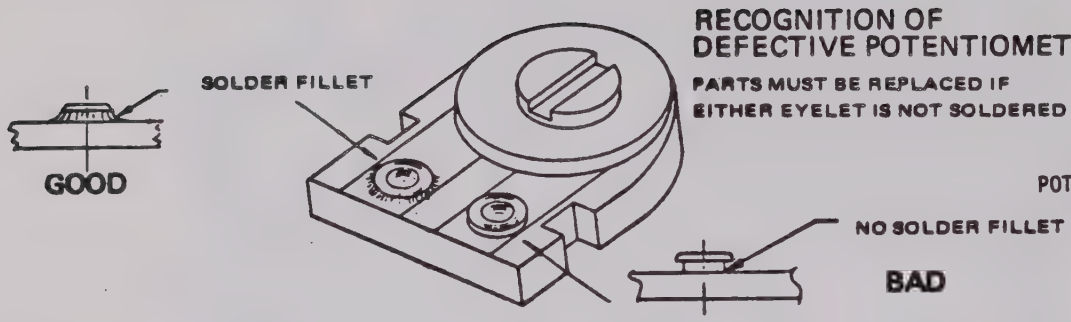


FIGURE 4
POTENTIOMETER FILLETS

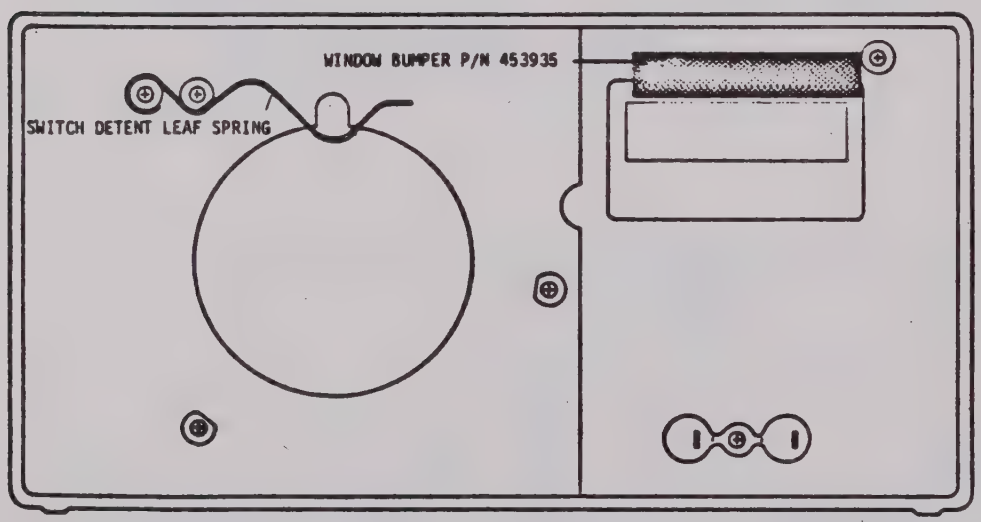


FIGURE 5
INSIDE METER CASE

8.2 FIELD SERVICE BULLETIN NO. 20-1113.

SUBJECT:
Model 2000 Series Danameters

PURPOSE:
To install a kit, P/N 437092, to eliminate misaligned, cracked or broken liquid crystal displays caused by mechanical impact.

ACTION:

1. PLACE THE CONTROL SWITCH IN THE OFF POSITION.

2. Loosen the captive screw on the battery cover.

3. Swing out the bail, slide the cover and remove.

4. Remove the center mounting screw at the center of the rear cover.

5. Remove the battery and fuse. Lift off the rear cover and guide the battery cable/connector through the hole.

6. Remove the reference cell, unless the meter is equipped with the "03" option (reference zener); and set aside for re-assembly.

7. De-solder the white shielded (+) and black (–) wires from the input terminals.

8. Remove four mounting screws for the PCB and remove from the case. (Do not remove the switch retaining screw.) (See Figure 1.)

9. Remove the LCD retaining strap, P/N 453896.

10. Remove the LCD, if cracked or broken; replace with P/N 920663.

11. Insert a conductive rubber strip (elastomer), P/N 453-897 from the kit, to the contact portion of the LCD that mates with the PCB connector. This insures electrical contact and equalizes the capture pressure of the mating surface (see Figure 2).

12. Insert a double sided adhesive strip, P/N 920508 from the kit, to the LCD retainer to prevent the LCD from shifting due to mechanical impact (see Figure 2).

13. Insert a foam rubber bumper, P/N 453940 from the kit, to the top of the digit chip (under the LCD). (See Figure 2.)

14. Insert a foam rubber bumper, P/N 453935 from the kit, to overlap the display window on the inside of the case without being visible from the front of the meter (see Figure 3).

    Note: The window and digital chip bumpers restrict the travel of the LCD during mechanical impact.

15. Re-assemble the LCD with screws, springs, and nuts. The nuts should have about three to four threads showing from the end of the screws.

16. Field Service Bulletin 20-1112 should be incorporated, at this stage of assembly; unless it has been previously performed.

17. Re-assemble the PCB in the meter case, placing the control switch in the 1KVDC/10μA position to align the switch detents with the leaf spring mounted to the meter case above the control switch (see Figure 1). (The PCB is mounted properly when the switch protrudes fully through the meter case and the switch detents normally.) (See Figure 3.)

18. Replace the four PCB mounting screws and check for proper detent action and place the switch IN THE OFF POSITION.

19. Re-solder the input terminals.

20. Re-install the reference cell, if necessary.

    Note: The following conditions can cause "loading" to the reference cell:

    a. The 9V battery disconnected AND
    b. The control switch NOT in the OFF position

    If the cell is temporarily loaded, it will indicate an increased value of the test reading. The test reading gradually decreases as the cell stabilizes. The time to stabilize depends on how severely the cell was loaded.

21. Replace the meter rear case feeding the battery cable/connector through the hole.

22. Replace the fuse and CAREFULLY connect the 9V battery, observing the connector polarity alignment.

EFFECTIVITY:
All Revision C main PCB assemblies, P/N 403767, shipped prior to 1 January 1975.

AUTHORITY:
E.O. 8613, 8879, and 8881/ Customer Service

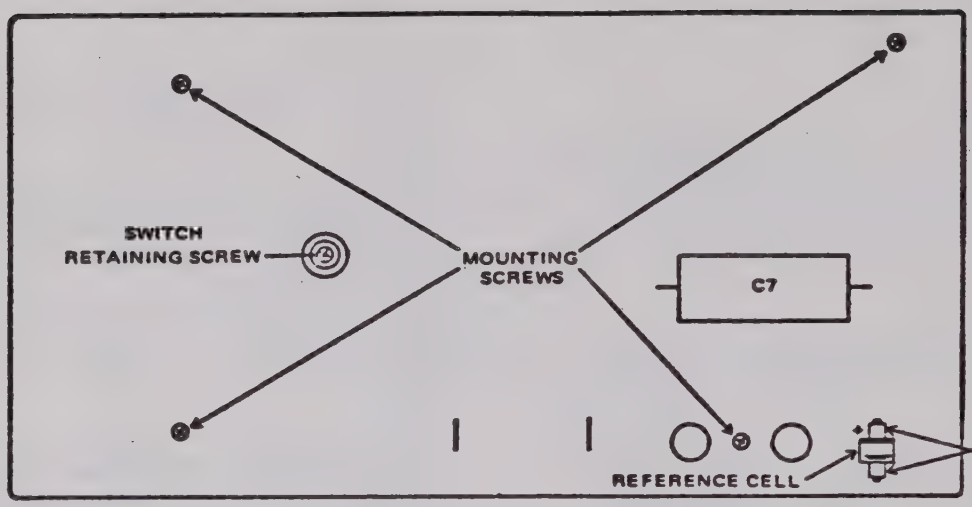


FIGURE 1
CIRCUIT SIDE
P/N 403767

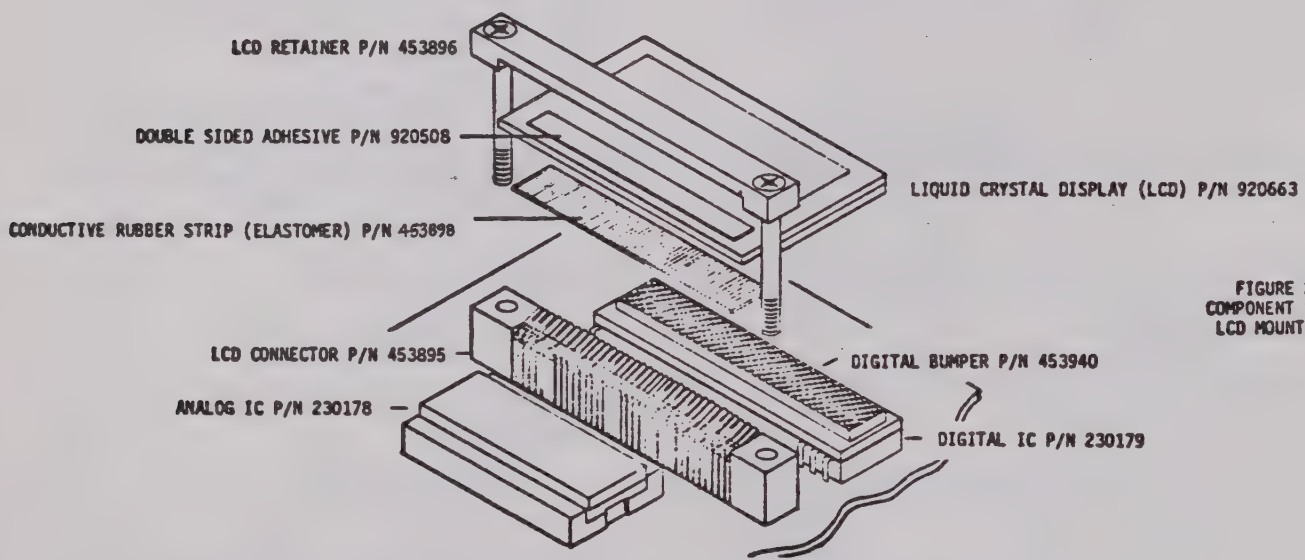

LCD RETAINER P/N 453896
DOUBLE SIDED ADHESIVE P/N 920508
LIQUID CRYSTAL DISPLAY (LCD) P/N 920663
CONDUCTIVE RUBBER STRIP (ELASTOMER) P/N 453898
LCD CONNECTOR P/N 453895
DIGITAL BUMPER P/N 453940
ANALOG IC P/N 230178
DIGITAL IC P/N 230179

FIGURE 2
COMPONENT SIDE
LCD MOUNTING

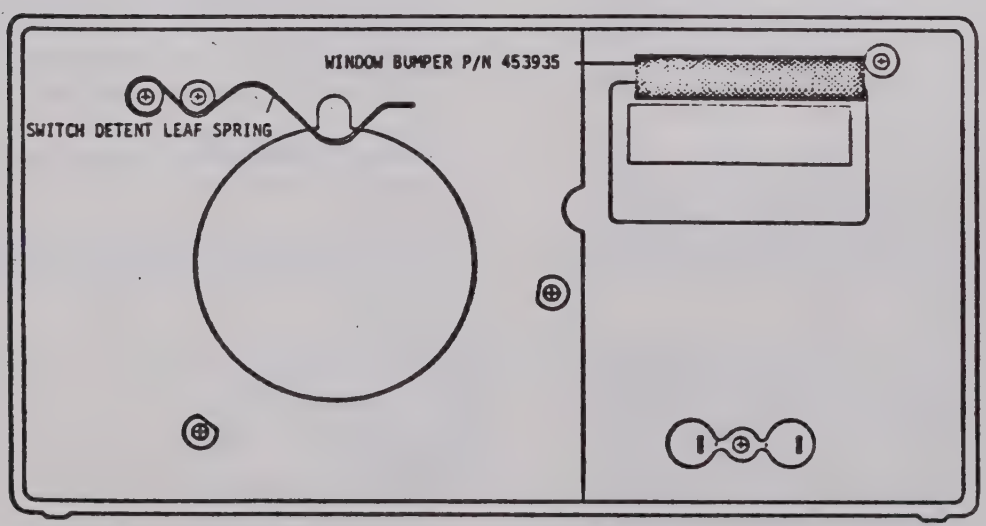


FIGURE 3
DANAMETER CASE
INSIDE

8.4 REWORK INSTRUCTIONS.

To add the Option 03, reference zener, to the 2000 Danameter (Revisions B & C).

Replacing the 1.35V battery reference cell with the reference zener diode produces a more stable reference over a wide temperature gradient and eliminates the necessity to replace reference cells due to cell "loading" and oxide degradation of mechanical contacts.

1. Set Danameter switch to the "OFF" position (detent).
2. Loosen the captive screw on the battery cover.
3. Swing the bail handle away from the back cover of the DMM and slide the cover up.
4. Disconnect and remove the 9V battery and the fuse. Lift off the back panel and guide the battery cable/connector through the hole in the back cover.
5. De-solder the cable (+) and black wire (–) to the input jack terminals.
6. Remove the PCB mounting screws (4 # 1 phillips). See Figure 1.
7. Remove the PCB assembly from the case. When the assembly is free from the case, the Function/Range Switch is NOT held in the "OFF" position because removal releases the switch cam from the detenting mechanism in the case. See Figure 2.
8. Remove the 1.35V Reference Cell from the clip contacts.
9. De-solder the reference cell clip contacts on both sides of the PCB and remove. Do not use a soldering GUN or an iron with a rating greater than 40 Watts.
10. Drill an 0.047 (3/64) inch hole in the approximate location shown on Figure 3, free from any adjacent etch lines on the component and circuit side of the PCB.
11. Install a 55.6K Ohm, 5%, 1/4 Watt, carbon resistor P/N 010884 at the location for R26 and solder into place.
12. Install a 390K Ohm, 5%, 1/4 Watt, carbon resistor, R36, from a hole, previously occupied by the reference cell clip connector; to the drilled hole outlined in Figure 3. The drilled hole lead must be sleeved on the circuit side with teflon tubing and terminated or jumpered to a pad for the mounting post for potentiometer, R30. Solder all terminations. See Figure 4.
13. Install the Reference Zener diode, VR1, to the remaining, unused pads previously occupied by the clip connectors for the reference cell. The tab on the can of the zener should point towards the center of the PCB (see Figure 3) before soldering into place on both sides of the assembly.
14. Install a jumper from switch contact pad # 29 (common) to switch contact pad #35, which permanently connects the anode of VR1 to common, disabling switch #35. See Figure 4.
15. Remove all solder flux from the reworked areas with an approved solvent. If the assembly is immersed in an ultra-sonic cleaner or a de-greasing tank, the Function/Range Switch must be disassembled to replace the Cramolin TM (cleaner-lubricant) paste on the switch contact pad surfaces and cam lobes. See Figure 5 and 5a. Note the mechanical sequence of the shaft bushing, flat metal washer, compression spring, flat metal washer, and self-tapping screw for disassembly and re-assembly, if required, to prevent bent and/or broken switch contacts due to improper alignment of the Function/Range switch contacts with the cam lobes. See Figure 6.
16. When the assembly is to be installed in the meter case, a bent paper-clip, soldering-aid tool, or equivalent must be used to compress the switch detent leafspring to mate with the Function/Range switch knob detents. See Figure 2.
17. Set the Function/Range switch to the "OFF" position and re-assembly in the reverse order, Steps 6 thru 2.
18. Check all functions per range and re-calibrate, if necessary.

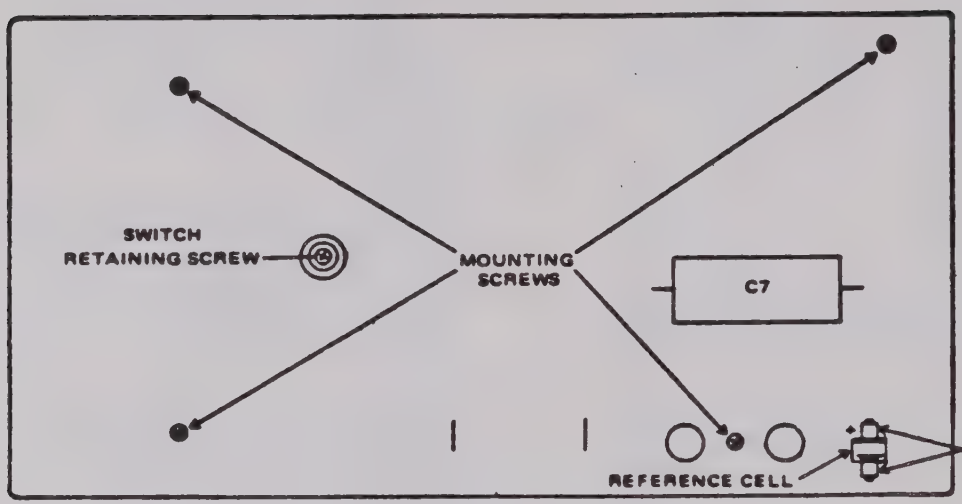


Figure 1

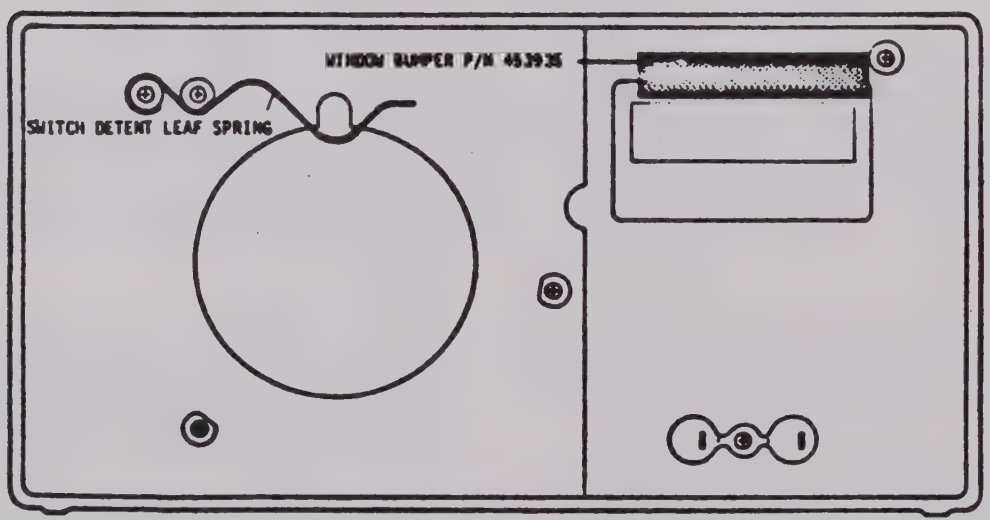


Figure 2

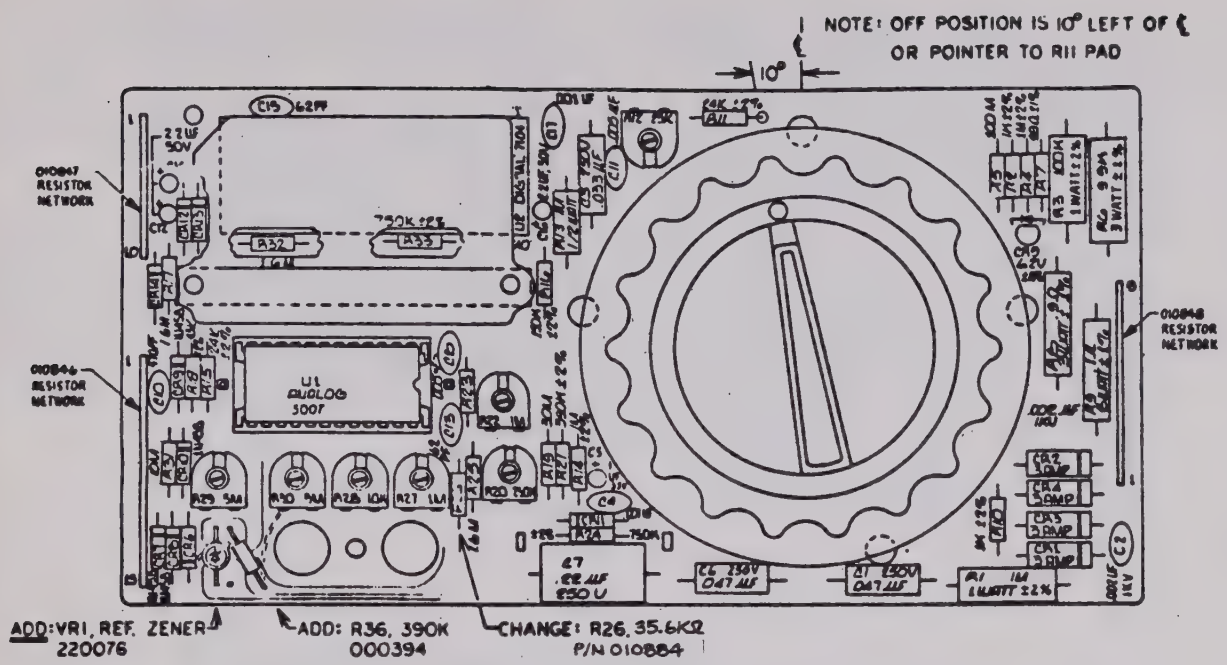


Figure 3

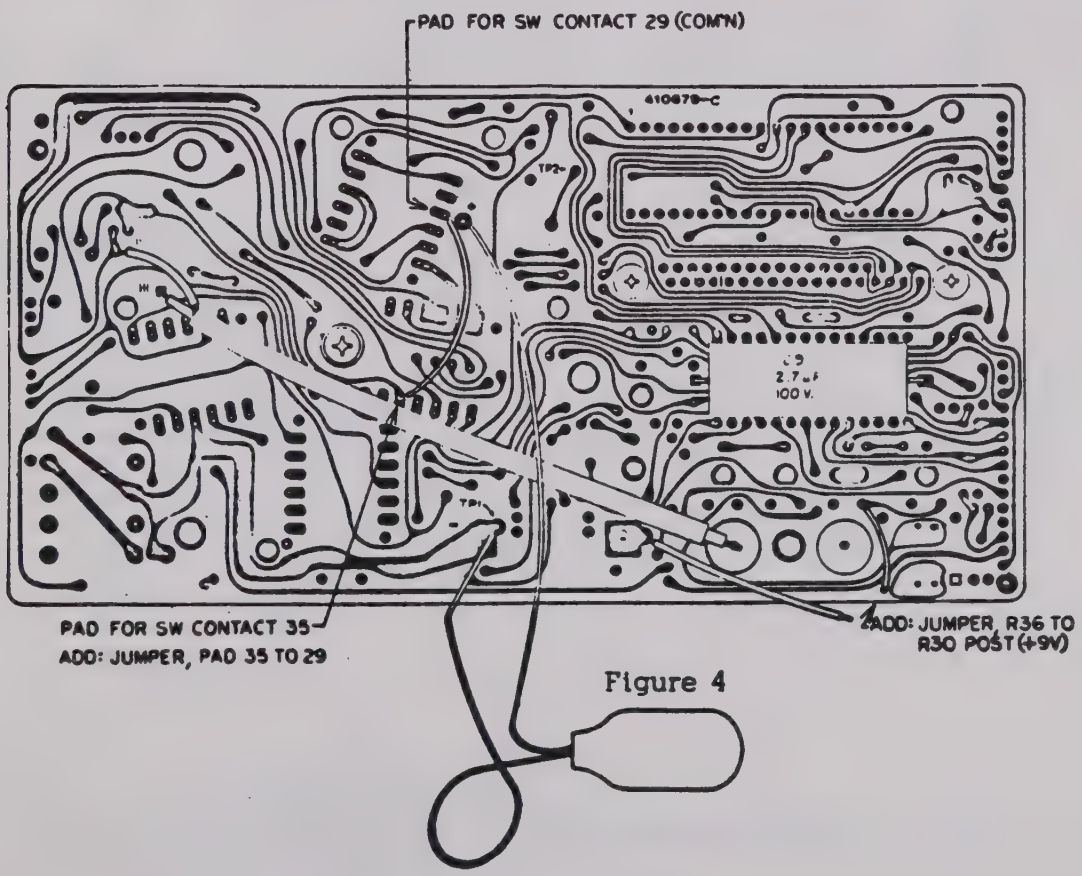


Figure 4

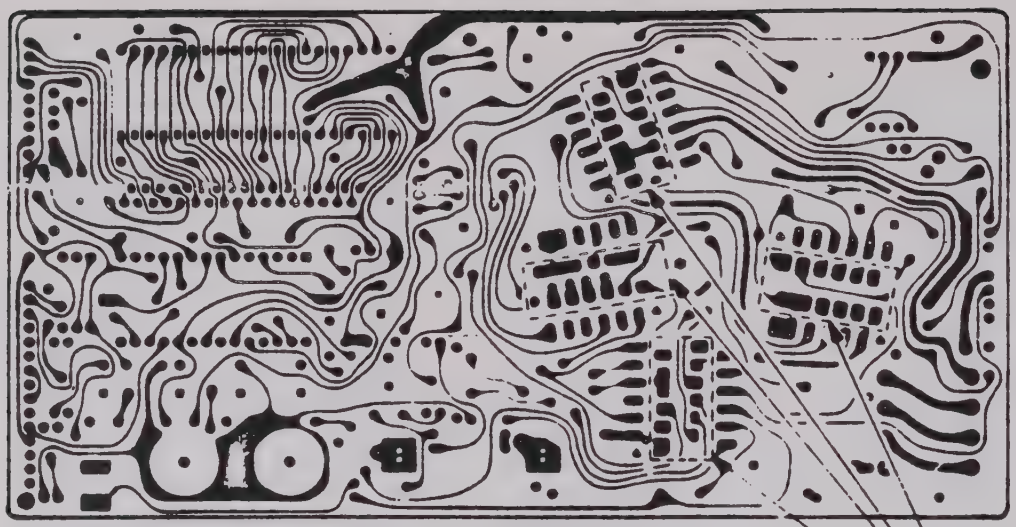


Figure 5

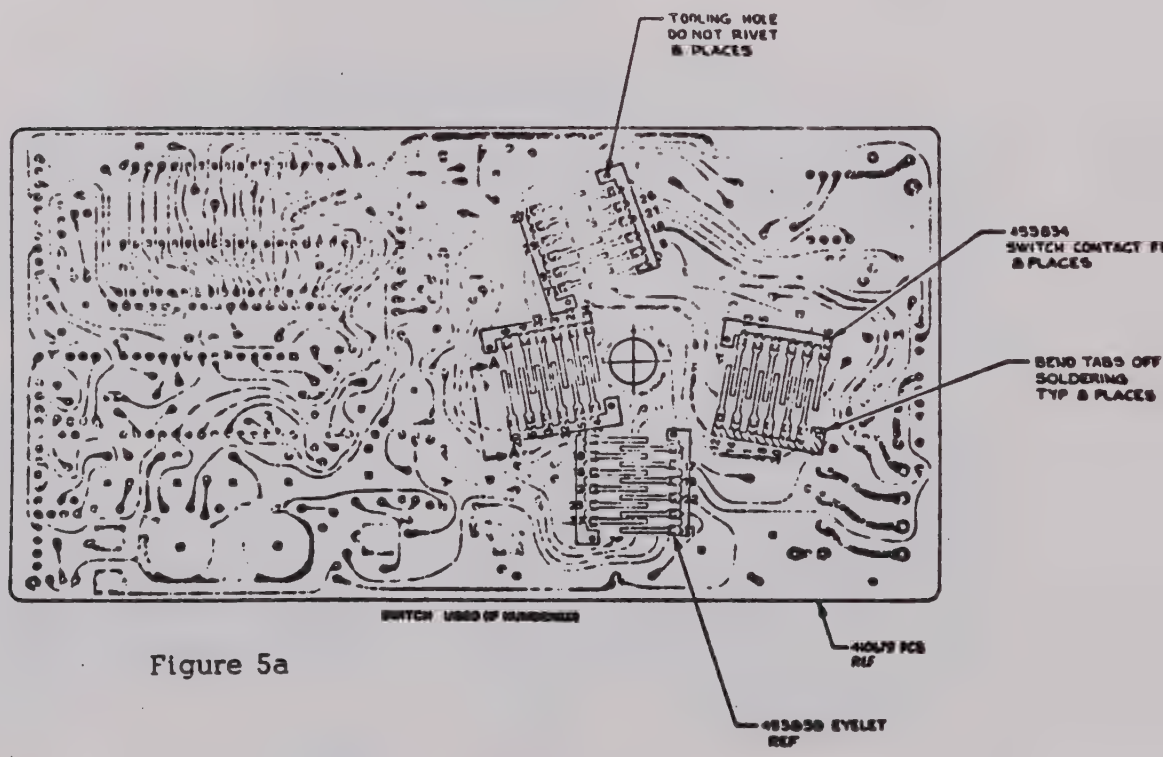


Figure 5a

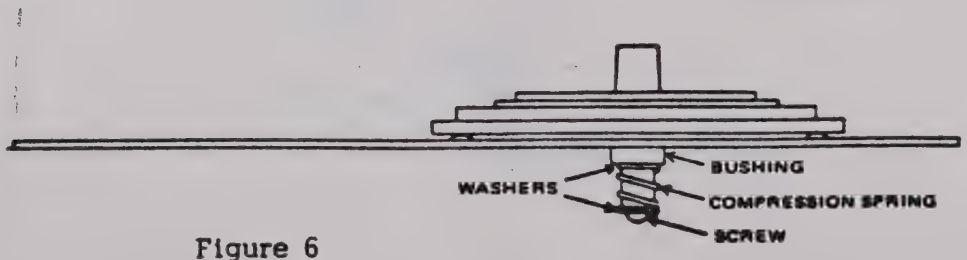


Figure 6

8.5 FIELD SERVICE BULLETIN NO. 20-11141.

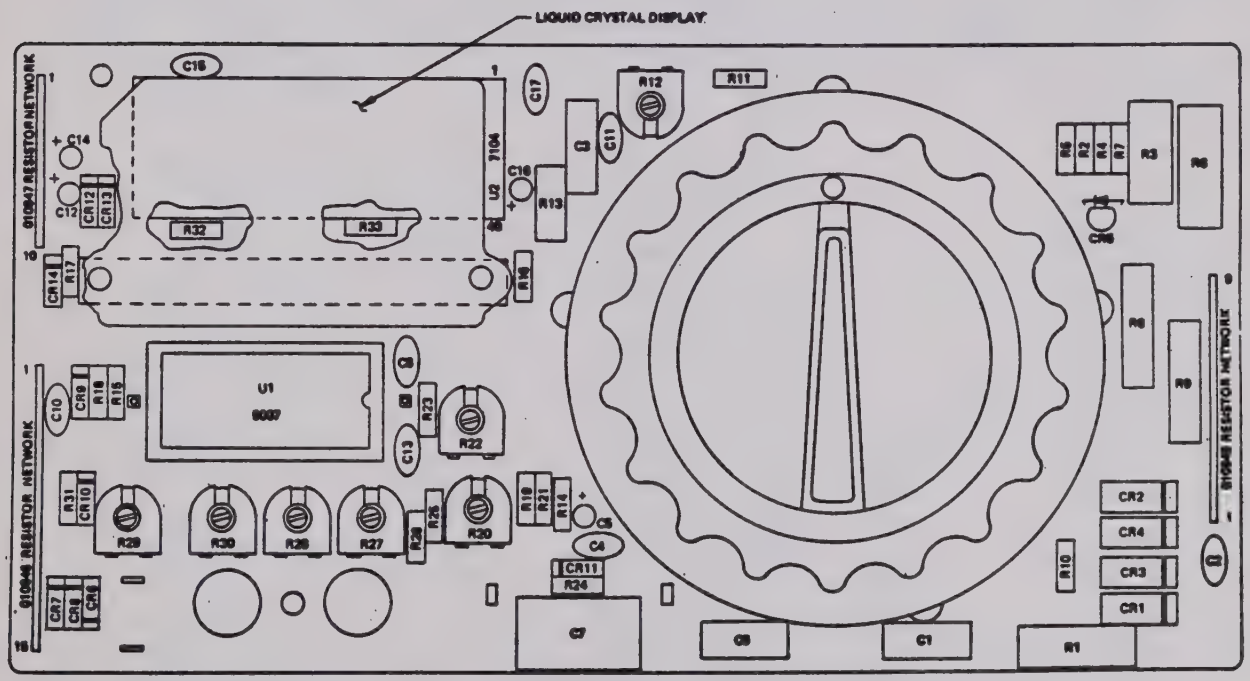
SUBJECT:
Dana Model 2000/2100 (Danameters) Decimal Point Annunciation.

PURPOSE:
To eliminate multiple decimal points on the Danameter Liquid Crystal Display (LCD) by increasing the "turn-off" margin for the digital chip drive. This phenomenon occurs in hemispheric regions where meteorological conditions increase the relative humidity (RH) to a point where leakage develops in the decimal switches.

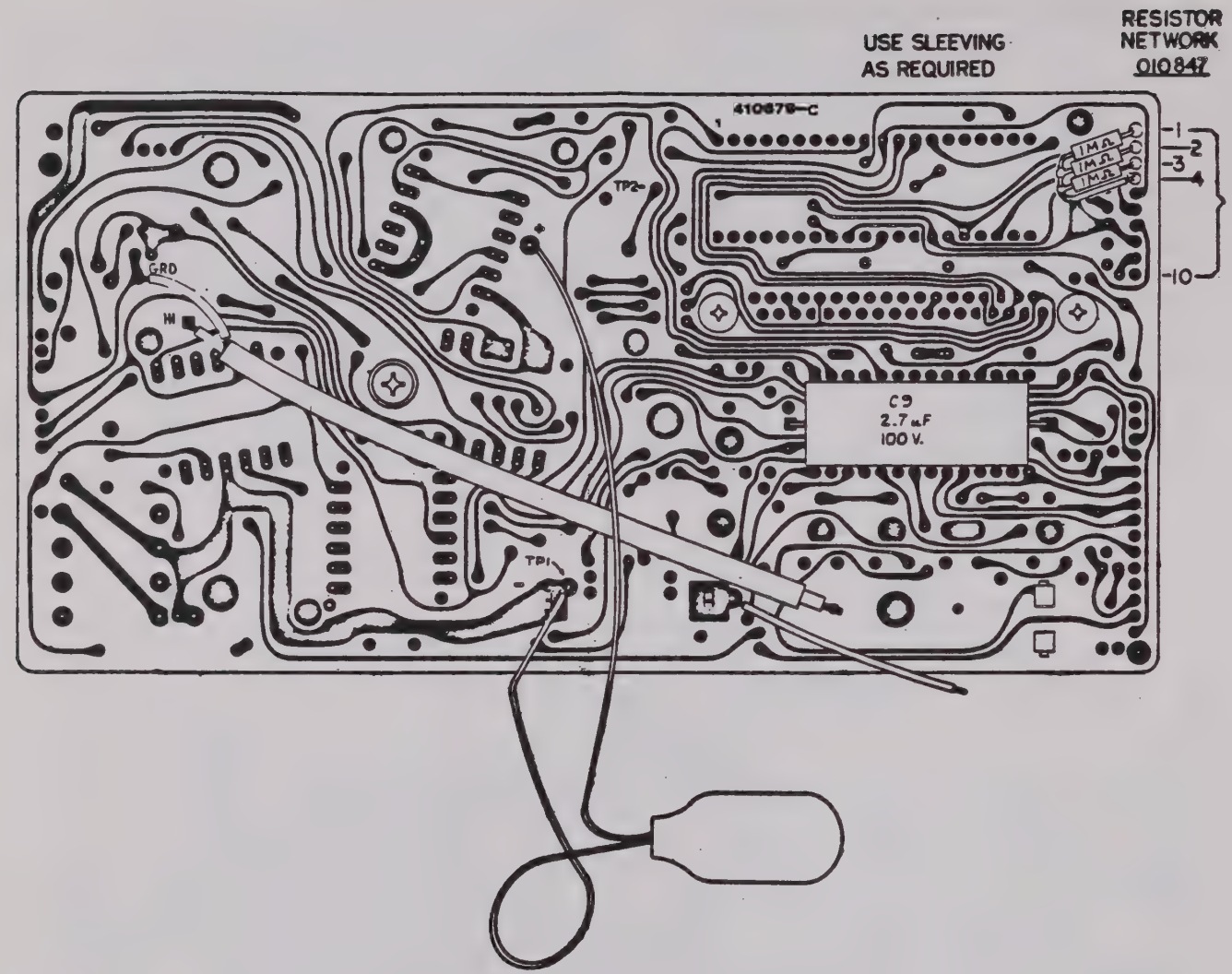
ACTION:
On the main circuit board, P/N 410679 (2000) and P/N 410-703 (2100), add three 1M Ohm, 5%, 1/4 Watt, Carbon Composition resistors to the resistor network, P/N 010847, at Pins 1, 2, and 3 and terminate the resistors to Pin 4. This parallels the internal 10M Ohm resistors with individual 1M Ohm resistors for all Danameter revisions. (See illustrations.)

EFFECTIVITY:
All Danameters (2000/2100) experiencing multiple decimal points.

AUTHORITY:
E.O. 11175



See rework on reverse side.



NOTES:

1. Example shown is an early 2000, but applies to all meters.

2. Function/Range switch must be in the "OFF" position.

3. Remove battery and rear panel (only).

4. Use a low wattage soldering iron (NOT GUN).

5. Clean any excess solder flux with alcohol or an approved solvent.

6. Re-assemble (no re-calibration is required).

RACAL-DANA Instruments Inc.

U. S. REPRESENTATIVES

ALABAMA
(800) 327-0853

ALASKA
(503) 241-8624

ARIZONA
(602) 252-5242

ARKANSAS
(918) 496-1457

CALIFORNIA
Northern California
(408) 727-2341
Southern California
(714) 859-8999
Los Angeles
(213) 628-8825

COLORADO
(303) 592-1717

CONNECTICUT
(617) 890-7195

DELAWARE
(609) 853-1605

DISTRICT OF COLUMBIA
(703) 941-0525

FLORIDA
(305) 724-0920 or
(800) 432-6288

GEORGIA
(800) 327-0853

HAWAII
(714) 859-8999

IDAHO
(714) 859-8999

ILLINOIS
(312) 932-4922

INDIANA
(800) RAC-DANA

IOWA
(800) RAC-DANA

KANSAS
(800) RAC-DANA

KENTUCKY
(800) RAC-DANA

LOUISIANA
(713) 780-2511

MAINE
(617) 890-7195

MARYLAND
(703) 941-0525

MASSACHUSETTS
(617) 890-7195

MICHIGAN
(800) RAC-DANA

MINNESOTA
(800) RAC-DANA

MISSISSIPPI
(800) 327-0853

MISSOURI
(800) RAC-DANA

MONTANA
(714) 859-8999

NEBRASKA
(800) RAC-DANA

NEVADA
(714) 859-8999

NEW HAMPSHIRE
(617) 890-7195

NEW JERSEY
(609) 853-1605

NEW MEXICO
(602) 252-5242

NEW YORK
(516) 242-3454

NORTH CAROLINA
(800) 327-0853

NORTH DAKOTA
(800) RAC-DANA

OHIO
(800) RAC-DANA

OKLAHOMA
(918) 496-1457

OREGON
(503) 241-8624

PENNSYLVANIA
Eastern
(609) 853-1605
Western
(800) RAC-DANA

PUERTO RICO
(305) 724-0920

RHODE ISLAND
(617) 890-7195

SOUTH CAROLINA
(800) 327-0853

SOUTH DAKOTA
(800) RAC-DANA

TENNESSEE
(800) 327-0853

TEXAS
Austin
(512) 451-5174
Dallas
(214) 661-0300
Houston
(713) 780-2511
San Antonio
(512) 342-3031

UTAH
(714) 859-8999

VERMONT
(617) 890-7195

VIRGINIA
(703) 941-0525

WASHINGTON
(503) 241-8624

WEST VIRGINIA
Eastern
(703) 941-0525
Western
(800) RAC-DANA

WISCONSIN
(800) RAC-DANA

WYOMING
(714) 859-8999

CANADA
Ontario
(416) 625-0600 or
(613) 725-0288
Quebec
(514) 744-5829
Alberta
(403) 458-4669
British Columbia
(604) 434-2611

FACTORY SERVICE

RACAL-DANA INSTRUMENTS INC.
4 Goodyear Street
Irvine, California 92714
Telephone: (714) 859-8999

PRODUCT SERVICE TWX 910-595-1136

REGIONAL SERVICE CENTER

RACAL-DANA INSTRUMENTS INC.
5101 "D" Blacklick Road
Annandale, Virginia 22003
Telephone: (703) 941-0525

REPAIR REQUEST FORM

To allow us to better understand your repair requests, we suggest you use the following outline and include a copy with your instrument to be sent to your local Racal-Dana repair facility.

Model Number _____ Options _____ Date _____

Serial Number _____ P. O.# _____

Company Name _____

Address _____

City _____ State _____ Zip Code _____

Contact _____ Phone Number _____

1. Describe, in detail, the problem and symptoms you are having.

_____

_____

2. If you are using your unit on the bus, please list the program strings used and the controller type, if possible.

_____

_____

3. List all input levels, and frequencies this failure occurs.

_____

_____

4. Indicate any repair work previously performed.

_____

_____

5. Please give any additional information you feel would be beneficial in facilitating a faster repair time. (I. E., modifications, etc.)

_____

_____

www.manualsplus.com
1026960

SE Laboratories
LOC: JJ4
MAN – 07542